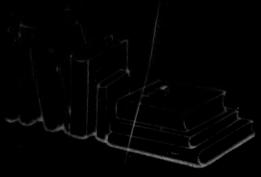
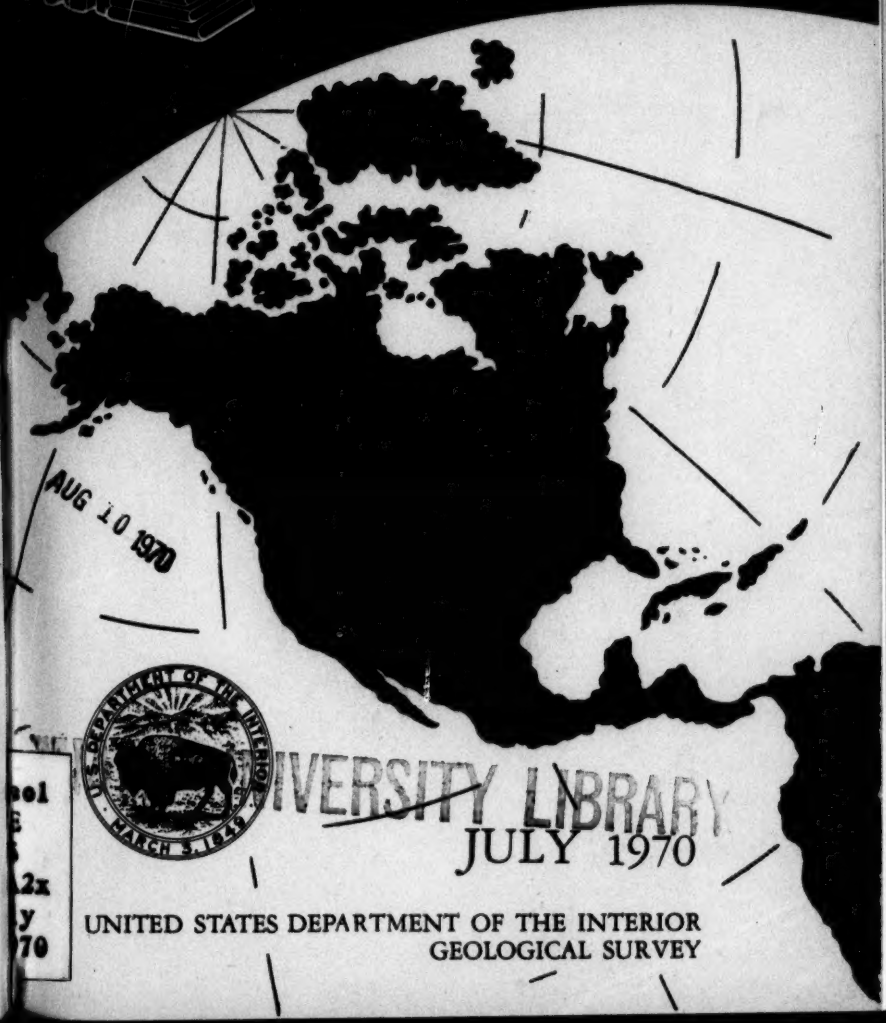
# ABSTRACTS OF NORTH AMERICAN GEOLOGY





AUG 10 1970

IVERSITY LIBRARY

JULY 1970

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

ol
2x
y
70

# ABSTRACTS OF NORTH AMERICAN GEOLOGY

July 1970

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1970

Geol
QE
75
.A2x
Jly-Dec
1970

UNITED STATES DEPARTMENT OF THE INTERIOR

WALTER J. HICKEL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. Price 75 cents (single copy). Subscription price: $9.00 a year (12 monthly issues); $2.25 additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (October 10, 1968). (exp. 12/71)

7-22-8

# ABSTRACTS OF NORTH AMERICAN GEOLOGY

## INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with small circulation (such as dissertations, open-file reports of memorandums) or of other papers presented orally at meetings.

The Abstracts is an additional reference tool but does not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology are published each year. The Bibliography includes citations and subject index for a calendar year.

The numbers assigned to the abstracts in this publication are for reference in using the index; they are not order numbers. Publications cited here in abstract form are available in most geological libraries or through interlibrary loan.

Abstracts of North American Geology and the Bibliography are prepared by use of computer techniques. Each abstract, along with its indexing, is placed on magnetic tape and entered into a permanent data bank. The material prepared each month is published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

A list of journals commonly cited in Abstracts of North American Geology may be obtained by writing to the U.S. Geological Survey, Washington, D. C. 20242. Serial publications cited for the first time are as follows:

Canada Dept. Energy, Mines and Resources Inland Waters Br. Rept. Ser.—Canada Department of Energy, Mines and Resources, Inland Waters Branch Report Series. Ottawa, Ontario, Canada.

Chem. Rev.—Chemical Reviews. American Chemical Society. Washington, D. C.

Chemistry—Chemistry. American Chemical Society. Washington, D. C.

Chemistry in Britain—Chemistry in Britain. Incorporating the Journal of the Royal Institute of Chemistry and the Proceedings of the Chemical Society. Chemical Society Publications. Letchworth, Herts., England.



569571

8-20-71

**The abstracts in this issue were prepared by Fred Barker, William B. Cashion, Georgianna D. Conant, Dennis P. Cox, Wallace deWitt, Jr., Andrew Griscom, Elizabeth Hambleton, Philip T. Hayes, D. L. Jones, Virginia M. Jussen, B. H. Kent, E. R. Landis, Elisabeth S. Loud, David H. McIntyre, Edwin T. McKnight, Mildred C. Mead, E. A. Merewether, Willis H. Nelson, Virginia S. Neuschel, George Plafker, Henry W. Roehler, Edward T. Ruppel, E. G. Sable, Marie Siegrist, Bernadine D. Tschudy, Elazar Uchupi, R. E. VanAlstine, Gregg Vane, Dorothy B. Vitaliano, and Holly C. Wagner.**

# ABSTRACTS

**Aaron, John M.** *See* McIntyre, David H. 00131

**Abdel-Khalek, M. Lotfi.** *See* Khoury, S. G. 00164

07284 **Adegoke, Oluwafayisola S.** Stratigraphy and paleontology of the marine Neogene formations of the Coalinga region, California: California Univ. Pubs. Geol. Sci., v. 80, 269 p., illus., geol. maps, 1969.

The Neogene formations include strata from the middle Miocene Temblor Formation to the late Pliocene San Joaquin, having a total thickness of 10,000 feet in the outcrop section. The geology of the Coalinga Anticline and Reef Ridge areas is described. From 217 localities, 314 species of larger invertebrates representing 117 genera are recorded; 13 new species and 9 new subspecies are described. These faunas indicate depth of deposition of most formations, and assemblages provide evidence of gradual cooling. The Temblor Formation, McLure Shale, Santa Margarita, Etchegoin, and San Joaquin Formations are correlated with those in other areas. The sequence is divided into eight major biostratigraphic units (faunizones A-H), which are subdivided into 16 units (zonules 1-16). [Systemic paleontology of species of seven invertebrates and two vertebrates is given and fossil locations are described.] — *from* Author's abstract

07728 **Ahmad, N.; Jones, Robert L.** A Plinthaquult of the Aripo Savannas, North Trinidad — [Pt.] 2, Mineralogy and genesis: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 765-768, tables, 1969.

Weathering of moderately fine alluvial fan material results in the formation of kaolinite from mica; minor vermiculite intermediates also occur. An argillic horizon containing ferruginous mottles that harden irreversibly on drying occurs under a surface albic horizon. Mn-poor dehydrated $Fe_2O_3$ nodules up to 30 years old do not contain crystalline Fe minerals. The ochreous-mottled horizon overlying the nodule-bearing horizon contains lepidocrocite and goethite. — Soil brief

07559 **Akella, Jagannadham; Kennedy, George C.** Studies on anorthite + diopside$_{50}$-hedenbergite$_{50}$ at high pressures and temperatures [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 251-252, 1969.

**Alford, John T.** *See* Putman, George W. 07110

07324 **Al-Hashimi, Abdul Razak K.** A study of copper dispersion in the Boulder batholith, Montana [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2248B-2249B, 1969.

**Allen, J. R.** *See* Schopf, T. J. M. 07482

07271 **Allen, J. S.** Geophysical activity in 1968: Geophysics, v. 34, no. 6, p. 821-847, illus., tables, 1969.

Total expenditures for all types of surveys on a worldwide basis during 1968 were up one percent from 1967. Expenditures for petroleum exploration were down one percent; for mining, up 28 percent; for groundwater, engineering, and construction up 62 percent; and for oceanographic surveys, up 325 percent. The United States led in petroleum exploration, followed by Africa; Canada led in mining exploration, followed by the United States; and the United States led in groundwater, engineering,

and construction exploration, followed by the Far East. Seismology led in data gathering by 92.7 percent of the total, and in general, total crew-months of geophysical surveys for petroleum exploration were down 14 percent from 1967. — GV

**Allison, E. C.** *See* Normark, W. R. 07703

07346 **Al-Sinawi, Sahil Abdulla.** An investigation of body wave velocities, attenuation and elastic parameters of rocks subjected to pressure at room temperature [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2260B-2261B, 1969.

07072 **Alterman, Z.** Higher-mode surface waves, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 265-272, illus., 1969.

Combined with data from the lower modes and from traveltimes, the study of higher modes is expected to give a more accurate determination of earthquake sources and of the structure of the Earth. — *from* Author's conclusion

07234 **Alvarez, Ticul.** Restos fosiles de maníferos de Tlapacoya, Estado de México (Pleistoceno-Reciente) [with English summ.], *in* Contributions in mammalogy — A volume honoring Prof. E. Raymond Hall: Kansas Univ. Mus. Nat. History Misc. Pub. 51, p. 93-112, illus., 1969.

Excavations for early man in the Valley of Mexico have uncovered two beds yielding abundant bones of mammals in the Tlapacoya area. The oldest is a volcanic ash; the bed above it was radiocarbon dated at about 24,000 yr. Bones in this ash belong mainly to aquatic birds, which will be described elsewhere; associated mammals are mostly small. *Lutra canadensis* and *Neochoerus pinckneyi* indicate a climate more humid than the present; *Mormoops megalophylla*, a bat, may indicate a warmer climate. The younger bed, dated at about 22,000 yr, contains mostly bones of large mammals that were probably brought in by man, as they are associated with charcoal and grouped around large stones. Most of the bones are of a deer, *Odocoileus halli*, n.sp., largest known of the genus. Most of the other mammal species live in the area today. — VMJ

07260 **Ambach, W.** Ein Beitrag zur Kenntnis des Wärmehaushaltes des grönländischen Inlandeises [with English abs.]: Polarforschung 1968, v. 38, pt. 6, nos. 1-2, p. 207-211, illus., table [1969].

During the months of May, June, and July the heat budget [of the icecap] is nearly balanced, as on the average the absorbed global shortwave radiation is compensated by the net longwave flux, and the flow of sensible heat is compensated by the flow of latent heat. In spite of the large amount of the global shortwave radiation (715 cal/cm$^2$ day), only 10 cal/cm$^2$ day were consumed for the warming of the snow. This is only 1.4 percent of the energy supplied by the global shortwave radiation. The wind profile is logarithmic up to 2 m height. On the average the roughness-parameter amounts to 0.012 cm, the friction velocity to 28 cm/sec. — Author's abstract

**Amburgey, John W., Jr.** *See* Perhac, Ralph M. 07441

00137 **Amenta, Roddy V.** Sequence of deformation and metamorphism near Philadelphia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 10, 1970.

00138 **Anderson, F. D.** The Catamaran Fault of north central New Brunswick [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 10, 1970.

**Anderson, Franz E.** *See* Winstonk, Judith E. 07549

07229 **Anderson, Norman D.** Summer Institutes in Earth Science at North Carolina State University: Jour. Geol. Education, v. 17, no. 5, p. 191-193, 1969.

Earth science has been a required course in the eighth grade in the State since 1964, but few teachers were prepared to teach it. In 1966, a six-week NSF Summer In-

stitute in Earth Science was held, designed for teachers with little or no preparation. The program consisted of a four-semester-hour course in physical-historical geology and a two-semester-hour course in meteorology; field trips were included. In 1967, a special topics seminar-type course was added. Topics included earth materials and weathering, origin and nature of the Earth, earth movements and mountain building, and fossils and geologic time. A science education seminar was also held, working in small groups. Few teachers are taking their students on field trips in spite of the fact that 55 Geological Field Guides were prepared in 1961. A series of six field trips was conducted for teachers in Nov. 1968, and another Institute was held. — ESL

**Anderson, Richard C.** *See* Hester, Norman C. 07122

07147 **Andreasen, Gordon E.; Zietz, Isidore.** Magnetic fields for a 4 × 6 prismatic model: U.S. Geol. Survey Prof. Paper 666, 9 p., illus., 1969.

Magnetic fields have been computed for 4 × 6 (depth units) prismatic models with thicknesses ranging from 0.1 depth unit to infinity. For each model, the azimuth and inclination of polarization have been systematically varied from 0° to 90° and from 0° to 150°, respectively. In addition, the fields were computed for inclinations of the Earth's field ranging from 0° to 90°. The computation and contouring of the fields were accomplished by high speed digital computers and automatic data plotters. Both formulation and program listing are included. The 825 magnetic fields that make up this 4 × 6 model include the induced case and the remanent magnetization case. This suite of fields is primarily designed to aid the investigator in the geologic interpretation of observed magnetic anomalies. — Authors' abstract

**Andreasen, Gordon E.** *See* Zietz, Isidore. 07558

00139 **Anibal, Espejo C.; Mattson, Peter H.** Textural evidence for synorogenic intrusion of the Peekskill pluton, New York [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 10-11, 1970.

**Archambeau, Charles B.** *See* Smith, Stewart W. 07358

07722 **Armstrong, Augustus K.; MacKevett, E. M., Jr.; Silberling, N. J.** The Chitistone and Nizina Limestones of part of the southern Wrangell Mountains, Alaska — A preliminary report stressing carbonate petrography and depositional environments, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D49-D62, illus., table, 1969.

Carbonate petrographic and related studies of Chitistone and Nizina Limestones in parts of the southern Wrangell Mts. provide new information on depositional history, lithology, extent, and fauna. Upper Triassic carbonates disconformably overlie Nikolai Greenstone and conformably underlie the McCarthy Formation. Chitistone beds reflect inter- and supratidal conditions followed by low-energy restricted shallow-water marine interspersed with high-energy shoaling-water deposition. Nizina carbonates formed in deeper water on basinal slope of the drowned Chitistone carbonate platform and later on shallow carbonate shelves; rapid rise in sea level terminated carbonate deposition. Inferences on depositional environments are corroborated by distribution and nature of fossils. Possibly copper deposits in the lower Chitistone are genetically related to thermal brines associated with intertidal-supratidal rocks. — *from* Authors' abstract

**Armstrong, Richard L.** *See* Denton, George H. 07238

**Armstrong, Richard L.** *See* Stuiver, Minze. 07512

07314 **Aron, Gert.** Optimization of conjunctively managed surface and ground water resources by dynamic programming [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2152B, 1969.

07082 **Artyushkov, E. V.; Mescherikov, Yu. A.** Recent movements of the Earth's crust and isostatic compensation, *in* The Earth's crust and upper mantle: Am. Geophys. Union

Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 379-390, illus., table, 1969.

Recent vertical and horizontal crustal movements are components of three-dimensional deformation which also involves postglacial isostatic readjustment associated with movement in the mantle. Tectonic processes, volcanism, and upper mantle inhomogeneities are probably due to upward injection of large masses of light, heated material. Gravity convection may be the sole mechanism rather than heat convection. — MS

07302 **Aumento, F.** The Mid-Atlantic Ridge near 45° N. — [Pt.] 5, Fission track and ferro-manganese chronology: Canadian Jour. Earth Sci., v. 6, no. 6, p. 1431-1440, illus., tables, 1969.

Specimens from 42 dredge stations taken over a 120 × 220 km area across the axis of the Mid-Atlantic Ridge were dated by a fission track and ferro-manganese deposition rate methods; results were compared with previous K-Ar determinations. Chronological data are in close agreement with hypotheses of ocean floor spreading: ages increase outwardly in a systematic way from the Ridge axis, and although there is a scarcity of data on the eastern Crest Mts., a chronological axis of symmetry may exist coincident with the Ridge axis. Spreading rates fall into two distinct groups: a faster rate on Crest Mts. (average 3 cm/yr), and a slower rate on High Fractured Plateaus (average 1 cm/yr). The transition point between the two spreading rates coincides with morphological boundaries between the Crest Mts. and High Fractured Plateaus; this line of demarcation has significant structural and sedimentary implications. — *from* Author's abstract

07240 **Ayres, L. D.** Geology of Townships 31 and 30, Ranges 20 and 19, District of Algoma: Ontario Dept. Mines Geol. Rept. 69, 100 p., illus., tables, geol. maps, 1969.

The map-area is on the east shore of Lake Superior, 85 miles north of Sault Ste. Marie. A pre-Keweenawan metavolcanic sequence intertongues southwestward with metagraywacke and metasiltstone. Pre-Keweenawan ultramafic to granite and syenite intrusions underlie half the area. Intrusion began during volcanism and continued intermittently until late in the tectonic cycle. The sequence was isoclinally folded and regionally metamorphosed to greenschist and almandine amphibolite facies prior to intrusion of Gamitagama Lake Complex, which caused crossfolding. About 2,000 feet of Middle Keweenawan basalt, rhyolite, and conglomerate unconformably overlies earlier rocks. Dikes form a northeast-trending and two northwest-trending sets. About 600 feet of Cambrian sandstone is in fault contact with older formations. Latest movement was post-Precambrian. Associations of concentrations of metals are described. — *from* Author's abstract

**Babcock, Larry L.** *See* Nordeng, Stephan C. 07702

07118 **Baer, James L.** Paleoecology of cyclic sediments of the lower Green River Formation, central Utah: Brigham Young Univ. Geology Studies, v. 16, pt. 1, p. 3-95, illus., tables, 1969.

Paleoecology of a 127-ft section, 350 feet above the Green River base was interpreted from stratigraphic, sedimentation, chemical, mineral, and paleontologic data. It is divisible into five shale-carbonate-shale cycles, containing all major lithologies found elsewhere in the Formation. Cycles are subdivided into two delta, one transition, and two lacustrine cycles. Four distinctive sedimentary features found are described. One hundred nine samples were analyzed, and element ratios calculated and interpreted as environment indicators. Analcite and illite were found to be more common in lake deposits. Paleontologic criteria are the best environment indicators. Sediments accumulated in a deltaic environment where deposition was controlled by position of distributaries; the delta gave way to a marsh, and then to a marginal lake lagoon; finally lake sediments transgressed over the lagoon. — *from* Author's abstract

07325 **Baetcke, Gustav Berndt.** Stratigraphy of the Star Range and reconnaissance study of three selected mines [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2249B, 1969

**Bailey, E. H.** *See* Jones, D. L. 07760

07621 **Bailey, N. G.; Colton, G. W.; Lucchitta, Ivo.** Simulated lunar crater fields near Flagstaff, Arizona — Their geology, preparation, and uses, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D172-D179, illus., tables, 1969.

Two crater fields were constructed in Cinder Lake near Flagstaff, Ariz., for experimental purposes connected with manned investigations on the Moon. They are 1:1-scale replicas of parts of preliminary Apollo landing site II-P-6-1 in Mare Tranquillitatis. Realism was facilitated by the lack of vegetation in Cinder Lake, as well as by its flatness and cover of unconsolidated basaltic pyroclastic debris. Explosive charges of various predetermined sizes were buried at different depths in the ash and cinders, using Lunar Orbiter II photographs of site II-P-6-1 as a guide. The 569 craters excavated by detonation of the charges match, in size and distribution, the craters visible in the Orbiter photographs. The cratered fields are being used to test, and experiment with, tools and procedures for geologic exploration on the Moon. — Authors' abstract

**Baird, Ralph W.** *See* Knisel, Walter G., Jr. 00117

00105 **Ballard, J. Alan; Feden, Robert H.** Diapiric structures on the Campeche shelf and slope, western Gulf of Mexico: Geol. Soc. America Bull., v. 81, no. 2, p. 505-512, illus., 1970.

Recently collected seismic reflection profiles reveal numerous emerged and buried diapiric structures along the Campeche Shelf and slope, south of 20°N. latitude. Slope diapirs have steep sides, relatively flat tops, and a subsurface reflector which may be an expression of caprock. Shelf diapirs are buried structures characterized by uniformly stratified sediments trapped between rising intrusives or displaced by numerous high-angle faults. The limited east-west distribution and the lack of magnetic signature suggest that Campeche Shelf and slope diapirs are salt structures colinear with previously mapped salt domes in the Tabasco-Campeche Basin and the Sigsbee Knolls. — Authors' abstract

00140 **Balsam, William L.** Reinterpretation of a Lower Cambrian archaeocyathid reef [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 11, 1970.

**Bambach, Richard K.** *See* Levinton, Jeffrey S. 07416

07641 **Bandy, Orville L.; Casey, Richard E.** Epoch boundaries and paleotemperature cycles of the later Cenozoic [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 252-254, 1969.

00133 **Barker, Fred; Peterman, Z. E.; Marvin, R. F.** Precambrian melasyenite of Ute Creek, San Juan Mountains, Colorado — Chemistry, petrology, and strontium isotopes: U.S. Geol. Survey Bull. 1311-C, p. C1-C15, illus., tables, 1970.

A stock of melasyenite that is exposed in an erosional window through younger rocks at Ute Creek in the north-central San Juan Mts., Colo., petrographically is oversaturated but chemically shows kinship with potassic shonkinites and lamprophyres. High water content of this magma caused early crystallization of much hornblende and biotite which, compared with augite, are deficient in $SiO_2$ and caused the remaining liquid to become residually enriched in $SiO_2$. K-Ar apparent ages of 1,380 and 1,410 m. y. on biotite of two samples probably are minimal. The Ute Creek intrusive is similar in age and composition to potassic intrusives of the Powderhorn area to the north-northeast. The Sr-87/Sr-86 ratio of the melasyenite, corrected for an age of 1,400 m. y., compares closely with a predicted value of 0.7022 in the mantle. — FB

07718 **Barker, Fred.** Precambrian geology of the Needle Mountains, southwestern Colorado: U.S. Geol. Survey Prof. Paper 644-A, p. A1-A35, illus., tables, 1969.

The Needle Mountains of southwestern Colorado are an uplifted mass of Precambrian rocks. Field, petrographic, and isotopic studies indicate that these rocks were formed in two orogenic cycles. The first cycle occurred about 1,800 to 1,700 m. y. ago, and involved deposition of the Vallecito Conglomerate, volcanic and sedimentary rocks of the Irving Formation, and volcanic(?) parent rocks of the Twilight Gneiss. Intense folding, metamorphism to amphibolite facies, and intrusion of the Tenmile and Bakers Bridge Granites followed. After deep erosion the younger cycle took place 1,650 to 1,450 m. y. ago, and involved deposition of quartz sand and clay of the Uncompahgre Formation, folding and metamorphism, and intrusion of the Eolus Granite, Electra Lake Gabbro, and Trimble Granite. — FB

07173 **Barksdale, Julian D.; Mallory, V. Standish; McKee, Bates.** Laboratory manual for elementary geology (2d edition): Palo Alto, Calif., Pacific Books, 93 p., illus., tables, 1969; originally published 1968.

The primary emphasis in this laboratory guide for a one-quarter course is on physical geology, although there is material on historical geology for a one-semester course. The manual must be used in conjunction with a textbook and lecture material. The method employed is essentially question and answer, but is designed to provoke thought and to call attention to criteria that may be used for solving problems. — MCM

07560 **Barnes, David F.** Lack of isostatic adjustment on two Alaskan continental margins [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 254-256, 1969.

**Barnes, H. L.** *See* Scott, S. D. 07485

07733 **Barnhisel, R. I.; Phillippe, W. R.; Blevins, R. L.** A simple X-ray fluorescence technique for the determination of iron and manganese in soils and concretions: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 811-813, illus., table, 1969.

A simple technique for the determination of Fe and Mn in concretions and soils was developed using X-ray fluorescence. A 25 mg sample was suspended in a one percent glue-methyl alcohol solution and transferred to a 4.25-cm circle of filter paper. The filter paper containing a thin layer of uniformly distributed sample was placed in an X-ray emission spectrograph for analysis, and highly reproducible and accurate results were obtained. Precision was achieved over a wide range of Fe and Mn oxide contents. — Authors' abstract

**Barton, Paul B., Jr.** *See* Metsger, Robert W. 07682

00211 **Bateman, P. C.; Dodge, F. C. W.** Variations of major chemical constituents across the central Sierra Nevada batholith: Geol. Soc. America Bull, v. 81, no. 2, p. 409-420, illus., table, 1970.

A study of 193 chemical analyses of plutonic rocks from 132 localities in the central Sierra Nevada shows that $K_2O$ decreases systematically westward, that $Fe_2O_3$ and $TiO_2$ may also decrease westward, and that FeO, MgO, and CaO may increase. The ratio $K_2O/SiO_2$ decreases westward across six of eight provisionally established sequences of granitic rocks. Compositional trends within sequences are different than the compositional changes that take place across the batholith. Progressive decrease of $K_2O$ in the Paleozoic and Mesozoic country rocks westward across the batholith is consistent with the anatectic model for its origin. However, it also is consistent with the hypothesis developed to explain chemical patterns in volcanic island arcs — that $K_2O$ increases toward continental land masses because of increasing depth of magma generation along landward-dipping seismic (Benioff) zones. — *from* Authors' abstract

**Bauer, John W.** *See* Parizek, Richard R. 07714

07189 **Baur, Werner H.** A comparison of the crystal structures of pseudolaueite and laueite: Am. Mineralogist, v. 54, nos. 9-10, p. 1312-1323, illus., tables, 1969.

The pseudolaueite and laueite crystal structures have as a common feature infinite chains of corner-linked Fe-coordination octahedra. The way in which these chains are linked by the phosphate groups and Mn-coordination octahedra into three-dimensional frameworks are topologically distinct. The details of the distortions of the coordination octahedra can be accounted for by the extended electrostatic valence rule, provided one considers the contributions of the hydrogen atoms. It is proposed that pseudolaueite and laueite are not true polymorphs because laueite contains appreciable amounts of $Mn^{3+}$ in the Mn-site. — Author's abstract

07282 **Baxter, James W.; Harvey, Richard D.** Alumina content of carbonate rocks as an index to sodium sulfate soundness — A preliminary report: Illinois Geol. Survey Indus. Minerals Note 39, 10 p., illus., table, 1969.

Core samples from the upper part of the St. Louis Limestone near Alton, Ill., were subjected to physical tests, chemical analyses, and mineralogical study to seek chemical and/or mineralogical indices that would be useful in preliminary evaluation of limestone deposits that are possible sources of aggregate for concrete. A correlation coefficient of 0.79 was obtained between alumina content and sodium sulfate soundness for the rocks examined, a variety of fine-grained limestones and a few dolomites. Sodium sulfate soundness tests are widely used for aggregate evaluation. The correlation appears to be significant and is notably better than correlations between sulfate soundness and other major chemical oxides or mineral constituents. — Authors' abstract

07114 **Beall, Arthur O.** Deep-sea drilling project throws new light on Gulf sedimentation: Oil and Gas Jour., v. 67, no. 48, p. 94-97, 100, 104-105, 107-109, 1969.

The more widely accepted theories concerning the physiography, structure, and sedimentation in the deep water Gulf of Mexico are reviewed in this article. Background for most of this comes from various geophysical measurements, but sediment data, which is described from three core holes drilled by a deep-sea drilling project, are used to extend some interpretations. — WBC

00197 **Beall, Arthur O., Jr.** Textural differentiation within the fine sand grade: Jour. Geology, v. 78, no. 1, p. 77-93, illus., table, 1970.

Separation of textural data on sands by factor analysis allows for a somewhat independent measure of the correspondence between environmental setting and textural composition. Thorough analysis of (1) vertical position within the sequence, (2) sedimentary structures, and (3) textural composition can be used to predict position within the fluvial-deltaic complex. Delta-front and abandoned distributary sands of this study are apparently texturally distinctive, being characterized by finer mean grain size, poor sorting, negative skewness, and high precentages of "mud." In contrast, the fluvial fine sands are generally coarser and show good sorting, positive skewness, and moderate to low percentages of "mud." — *from* Author's abstract.

00090 **Beals, C. S.** Impact craters and the relative ages of Earth and Moon: Nature, v. 225, no. 5230, p. 368-369, illus., 1970

Recent aerial photographic and ground studies of islands in the Lake of the Woods area of the Canadian Shield have revealed a conspicuous circular feature 16 km in diameter. It is suggested that the feature may have been formed at a very early period in the history of the Earth's crust, before solidification had proceeded to any great depth, as a secondary consequence of an impact event. One possible explanation of the small number of impact remains on Earth compared to the Moon is that if the Earth's surface was molten or partly so, or even if there was a very thin solid crust, conditions would be unfavorable for retaining permanent imprints of large meteor impacts. Possible confirmation of this idea may be found in the Moon landings. The lunar highlands, characterized by much larger numbers of craters than the younger maria, may have solidified at an earlier time than the Earth's surface. — DBV

07561 **Beard, John H.** Pleistocene paleotemperature record based on planktonic foraminifers, Gulf of Mexico [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 256-258, table, 1969.

**Beatty, Marvin T.** *See* Ranney, Richard W. 07731

**Beauchamp, Robert G.** *See* Kauffman, Erle G. 07398

**Beck, Carl W.** *See* Sunderman, Jack A. 07195

**Beck, Kevin C.** *See* Weaver, Charles E. 07537

07166 **Becker, Robert M.; Hooker, Verne E.** A method of determining in-situ stress in anisotropic rock: Soc. Mining Engineers AIME Trans., v. 244, no. 4, p. 436-445, illus., 1969.

The evaluation of in-situ rock stresses from measurements of the change in diameter of a borehole that is stress-relieved by overcoring has become a common practice. Generally the stress evaluation has been based on isotropic relations whereas rock in varying degrees is anisotropic. A plane elasticity solution for a circular hole along one axis of an orthotropic medium has been adapted to evaluation of in-situ stress. The necessary elastic parameters for this evaluation may conveniently be obtained from static tests on the overcore in conjunction with a consistent orthotropic thick-wall cylinder solution. The method and equations for the laboratory and field evaluations are summarized and illustrated. — Authors' abstract

07052 **Belousov, V. V.** Continental rifts, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 539-544, illus., 1969.

The largest system of continental rifts, represented by the grabens of east Africa, forms only a small part of the world rift system. Other continental rifts are the Rhine and Baikal fault troughs. Oceanic rifts are by far the most extensive in the worldwide system. Formation of this system is associated with the upper mantle rather than the crust. All of the continental rift zones are related to domed uplifts of the Earth's crust, exhibit close relationships with volcanic activity, and are zones of high seismicity indicating that displacement along graben faults is continuing in the present. — MS

07163 **Belousov, V. V.** Interrelations between the Earth's crust and upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 698-712, 1969.

Exchange of material between the crust and upper mantle, the peridotitic versus eclogitic composition of the upper mantle, and the postulated transformation of continental-type crustal material into oceanic-type material (the oceanization hypothesis) are among the many hypotheses that are reviewed with a view to pointing out problematic areas whose solution will result in greater understanding of processes in the Earth's interior. — MS

07320 **Benedict, Barry Arden.** Hydrodynamic lift in sediment transport [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2192B, 1969.

**Benton, L. F.** *See* Cardwell, L. E. 00078

**Berberian, Paul.** *See* Estes, Richard. 07286

00085 **Berger, Wolfgang H.; Soutar, Andrew.** Preservation of plankton shells in an anaerobic basin off California: Geol. Soc. America Bull., v. 81, no. 1, p. 275-282, illus., tables, 1970.

The sill depth (480 m) in the Santa Barbara Basin separates two strikingly different planktonic sediment assemblages. The anaerobic part of the basin below the sill depth contains abundant aragonitic shells (pteropods and pelecypods) and relatively

high concentrations of calcitic shells (planktonic foraminifera). In the oxygenated region above sill depth there are no aragonitic shells and concentrations of planktonic foraminifera are much reduced. The most important mechanism responsible for the differences between oxygenated and anaerobic calcareous assemblages probably is selective dissolution. The accumulation rate of large planktonic foraminifera in the anaerobic sediment provides an excellent measure of shell output. Comparison with the standing stock of planktonic foraminifera in the productive surface waters yields minimum turnover times of 2 to 3 weeks. — *from* Authors' abstract

**Berggren, W. A.** *See* Phillips, J. D. 07448

**Bergström, S. M.** *See* Raring, A. W. 07461

**Bermúdez, Pedro J.** *See* Seiglie, George A. 07746

**Berry, P. F.** *See* Rhodes, J. R. 07668

00217 **Berry, William B. N.** The base of the Devonian and an Early Devonian graptolite succession in central Nevada: Geol. Soc. America Bull., v. 81, no. 2, p. 513-520, illus., table, 1970.

A consensus among stratigraphers interested in the Silurian-Devonian boundary is that the *Monograptus uniformis* graptolite zone should be the base of the Devonian. Use of that zone makes correlation with it relatively easy as significant evolutionary developments in several fossil groups have been recognized close to the base of the zone. If the base of the *Monograptus uniformis* zone is used as the base of the Devonian, then three, and possibly four, graptolite zones may be recognized in Lower Devonian rocks of central Nevada. The zones are characterized by evolution within the *Monograptus hercynicus* group as well as the appearance of *Monograptus microdon*, *Linograptus posthumus*, and *Abiesgraptus*. The Nevada zonal associations may be recognized in both carbonate rocks and thrust-faulted argillaceous rocks. Most of the Nevada species appear to be slightly (probably subspecifically) different from their European relatives. — *from* Author's abstract

07736 **Berthois, L.** Contribution à l'étude sedimentologique du Kangerdlugssuaq, côte ouest du Groenland [with English and French abs.]: Medd. Grönland, v. 187, no. 1, 185 p., illus., tables, 1969.

In upper waters of this fjord, pH is highest, Ca poorer than in deep water, due to suspended microbiomass. In relation to chlorine, lowered by melt water but which increases deuterium, rocks in the glacier basin supply little Ca but are rich in K and Mg. Air bubbles from melting ice floes increase oxygen content. Sediment fractions relate to their iceberg source or talus slides in lateral deposits; sandy varves, common near the glacier front, are more scattered downstream. Morphoscopical curves pointing to processes are regular in midfjord sediments, but disturbed near shores by slumping or sand supplied by small ice tongues. Macroscopic mineral content is uniform; X-ray studies show absence of carbonates, much quartz and feldspar, less mica and ferrous chlorite, only a trace of clay minerals. Chemical analyses confirm the influence of acid rocks and minerals in sedimentation. Large C/N ratios result from lignified plant remains at bottom. — GDC

**Bhappu, Roshan B.** *See* Horst, William E. 07656

**Bhattacherjee, S.** *See* Mitra, G. B. 07199

07275 **Bingham, Roy H.** Springs in the Ozark region, northeastern Oklahoma: Oklahoma Geology Notes, v. 29, no. 6, p. 135-145, illus., tables, 1969.

Springs are a large potential source of good-quality water in the Ozark region. Their existence depends on position of the water table, topography, and lithology and structure of formations. Springs are more numerous where Mississippian chert, limestone, and shale outcrops are carved into deep valleys and steep hillsides. Most of the 29 springs sampled flow from bedding-plane cavities in the Reeds Spring For-

mation. The cherty residuum absorbs part of each rainfall, and transmits it downward. Discharge varies from 30-3,600 gpm from the various springs, and all water is of good quality. — ESL

07088 **Birch, Francis.** Density and composition of the upper mantle — First approximation as an olivine layer, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 18-36, illus., tables, 1969.

On the assumption of an olivine composition, the effect of temperature and pressure on velocities and density in the uppermost 200 km of mantle is analyzed. Interpretation of experimental data indicates the presence of a low-velocity zone, characterized by higher rather than lower density relative to over- and underlying layers. The velocity minimum is defined in terms of a layer of iron enrichment, to about 23 ± 2 percent of fayalite, between depths of approximately 90-140 km. — MS

07129 **Birks, L. S.** X-ray spectrochemical analysis (2d edition): New York and London, Interscience Publishers (Chemical Analysis, V. 11), 143 p., illus., tables, 1969; originally published 1959.

The objective and approach of this book are to explain underlying principles and practices which govern generation, dispersion, and detection of characteristic radiation and to show how data are interpreted to achieve quantitative analysis. Chapter headings are: simplified fundamentals; principles of X-ray generation, diffraction, and absorption; excitation for X-ray analysis; dispersion — spectrometer geometry and crystal properties; detectors and circuits; energy dispersion; analysis, precision, and accuracy; mathematical methods for quantitative analysis; applications and specimen preparation; and electron probe microanalysis. Appendixes cover spectral distribution from X-ray tubes, useful analyzer crystals; average values of fluorescent yields, and steps in selecting components and conditions and in performing quantitative analysis. Author and subject indexes are included. — MCM

**Blackburn, William H.** *See* Smith, Kenneth G. 07496

**Blevins, R. L.** *See* Barnhisel, R. I. 07733

07761 **Boneham, Roger F.** Earth science teaching in the secondary schools of Indiana: Indiana Acad. Sci. Proc. 1968, v. 78, p. 329-332, 1969.

An analysis of the educational background of secondary school earth-science teachers in Indiana proves that the average teacher, generally a male, has a master's degree in education or earth science, a bachelor's degree in biology, and more than twenty hours of advanced course work. He has taught earth science for the last two years and may have initiated the course he is now teaching, probably to ninth or tenth grade students in an urban school. About twenty percent of the teachers have a master's degree in earth science. Approximately fifty percent have attended a N.S.F. Summer Institute. The majority would like to expand the present courses and obtain better laboratory facilities and equipment. — EH

07211 **Bonoli, Luciano; Witherspoon, Paul Adam.** Diffusion of paraffin, cycloparaffin and aromatic hydrocarbons in water and some effects of salt concentration, *in* Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), p. 373-384, illus., tables, 1969.

Diffusion coefficients for 5 paraffin, 3 aromatic, and 3 cycloparaffin hydrocarbons in pure water have been measured, starting with saturated solutions, at temperatures of 2° to 60°C and using capillary-cell method; also with benzene in pure water at different initial concentrations at temperatures of 2° to 60°C; and on four paraffin hydrocarbons in solution with two different concentrations of NaCl at temperatures of 10° to 40°C. Because of very low solubilities of hydrocarbons, diffusion coefficients show little effect of initial concentration. For a forty-fold decrease in concentration, decrease in benzene diffusion averages about 10 percent. In presence of salt

a marked decrease in diffusion of paraffin hydrocarbons was found, explained by effects of ions in water which act as structure breakers but also provide obstacles to movement by diffusion. — GDC

**Boothroyd, Jon C.** *See* Hayes, Miles O. 00162

**Boresik, Maria.** *See* Ohmoto, Hiroshi. 07705

**Born, Stephen M.** *See* Ritter, Dale F. 07468

07115 **Börner, Udo.** Deerit, Howieit und Zussmanit, neue, seltene Mineralien von einem Steinbruch bei Laytonville in Nord-Kalifornien: Aufschluss, v. 20, no. 12, p. 338-341, illus., 1969.

The occurrence is described of these three rare amphibole minerals in an old stone quarry half way between Laytonville and Willits, in northern California, where metabasalt is in faulted contact with meta-sedimentary rocks in the Franciscan formation. These minerals are found in association with a great number of others in well fractured crystalline aggregates, as well as in typical single crystals up to 3 cm long and 2 cm thick. Distinctive characteristics are given briefly. — GDC

00141 **Borns, Harold W., Jr.; Calkin, P. E.** Multiple glaciation and dissipation of the last ice sheet in northwestern Maine [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 12, 1970.

00142 **Bothner, Wallace A.** Gravity study of the Exeter pluton, southeastern New Hampshire [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 12-13, 1970.

**Bouma, A. H.** *See* Santos, G. G. 07742

07562 **Bouma, Arnold H.; Rezak, Richard; Chmelik, Frank B.** Sediment transport along oceanic density interfaces [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 259-260, 1969.

**Boutte, Andre L.** *See* Moore, Clyde H., Jr. 07688

00084 **Bouwer, Herman.** Ground water recharge design for renovating waste water: Am. Soc. Civil Engineers Proc., v. 96, paper 7096, Jour. Sanitary Eng. Div. no. SA 1, p. 59-74, illus., table, 1970.

Soil and hydrogeologic conditions permitting, ground water recharge by surface spreading is an economic and esthetic way for further treatment or renovation of secondary sewage effluent, cannery wastes, or similar low-quality water. Design of a system of spreading areas with wells or drains for collecting reclaimed water should generally be based on: a maximum limit for the elevation of the water table mound beneath spreading areas; a minimum limit for underground detention time and travel distance as the water moves to wells or drains; and minimum contamination of ground water in the aquifer outside the recharge system. Hydraulic properties of aquifers can be determined by analog and field measurements; data are used to evaluate effective transmissibility for recharge, and to calculate water-table positions and underground detention times for a system of long, parallel spreading strips with wells midway between strips. — *from* Author's abstract

**Bowin, C. O.** *See* Emery, K. O. 00099

00203 **Braddock, William A.** The origin of slaty cleavage — Evidence from Precambrian rocks in Colorado: Geol. Soc. America Bull., v. 81, no. 2, p. 589-600, illus., geol. map, 1970.

Mesoscopic and microscopic features of Precambrian metasedimentary rocks in the northeastern Front Range, Colorado, indicate that the formation of slaty cleavage involved extensive intergranular movement in the form of laminar intrusion of sedi-

mentary material across bedding and the formation of clastic dikes. The formation of cleavage is believed to have been facilitated by high pore-fluid pressure. — Authors' abstract

00143 **Bragonier, William A.; Williams, Eugene G.** Genesis and geologic relations of the high-alumina Mercer fireclay, western Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 13, 1970.

**Bramlette, M. N.** *See* Bukry, David. 07681

07256 **Brandt, W. W.; Dovala, D. L.** Time-programmed mass spectrometry: Appl. Spectroscopy, v. 23, no. 6, p. 604-606, illus., 1969.

A 90°-sector mass spectrometer (Hitachi Perkin-Elmer Model RMU-6E) has been modified for continuous repeated scanning of the mass spectrum in up to seven separate steps of different duration. The detector sensitivity settings and scanning rates can be selected individually for each step so that precise scans of mass peaks in different parts of the spectrum can be obtained repetitively and with minimum supervision. The peak heights can be conveniently referenced to the mass peaks arising from suitable standard peaks, and a variety of kinetic measurements can thus be performed using this device. The programmer described here is very inexpensive, compared to certain other data acquisition systems, and it is probably useful in many other instrumental applications as well. — Authors' abstract

**Bratt, Judy M.** *See* Swain, Frederick M. 07750

**Bray, J. G.** *See* Naldrett, A. J. 07694

07365 **Brett, Robin; Higgins, G. T.** Cliftonite — A proposed origin, and its bearing on the origin of diamonds in meteorites: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1473-1484, illus., 1969.

Cliftonite, a polycrystalline aggregate of graphite with spherulitic structure and cubic morphology, is known in 14 meteorites. Some have considered it to be a pseudomorph after diamond, and have used the proposed diamond ancestry as evidence of a meteoritic parent body of at least lunar dimensions. Careful examination of meteoritic samples indicates that cliftonite forms by precipitation within kamacite. It has also been demonstrated that graphite with cubic morphology may be synthesized in a Fe-Ni-C alloy annealed in a vacuum. It is therefore suggested that a high pressure origin is unnecessary for meteorites which contain cliftonite, and that these meteorites were formed at low pressure. — GV

07603 **Brew, David A.; Muffler, L. J. Patrick; Loney, Robert A.** Reconnaissance geology of the Mount Edgecumbe volcanic field, Kruzof Island, southeastern Alaska, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D1-D18, illus., tables, 1969.

The postglacial Mt. Edgecumbe volcanic field contains at least 14 rock units ranging in composition from olivine-augite basalt to augite-bearing quartz latite. Mesozoic graywacke and slate and Tertiary granitic intrusions underlie gently dipping basalt forming the base of the pile. Andesite and basaltic andesite overlie the basalt near Mt. Edgecumbe and are probably overlain by dacite flows and cinder cones on its southwest flank. Mt. Edgecumbe and a nearby remnant of a similar cone are cut by latite domes; the remnant is the site of a caldera 1.6 km in diameter and 240 m deep. Widespread dacite(?) lapilli and ash probably resulted from explosive eruptions during formation of the composite cones. Nine chemical analyses define a smooth compositional trend that correlates with relative age of map units. The calc-alkaline magma series has a close relation to the high-alumina basalt series. — *from* Authors' abstract

**Bristow, Q.** *See* Darnley, A. G. 07665

**Brock, R. O.** *See* Peterson, J. B. 07635

00108 **Brookins, Douglas G.** Kimberlite at Winkler Crater, Kansas: Geol. Soc. America Bull., v. 81, no. 2, p. 541-545, illus., 1970.

Drilling over a magnetic anomaly in Winkler Crater, Kansas, has revealed the presence of abundant kimberlite fragments and the absence of key stratigraphic units in a highly brecciated and recemented pipe-like body. No evidence for meteoritic impact has been found in the crater, and Winkler Crater should be removed from the published lists of the world's possible meteorite craters. — Author's abstract

07721 **Brosgé, W. P.; Lanphere, M. A.; Reiser, H. N.; Chapman, R. M.** Probable Permian age of the Rampart Group, central Alaska: U.S. Geol. Survey Bull. 1294-B, p. B1-B18, illus., tables, 1969.

The Rampart Group, consisting largely of volcanic rocks, was assigned by Mertie in 1937 to the Mississippian System because of bryozoans found in a limestone bed thought to be in or below the Rampart. Examination of new collections as well as the old collections shows that this limestone bed is within the volcanic sequence and is more likely to be Permian than Mississippian in age. The limestone itself is composed largely of pelecypod prisms and in this respect resembles one of the Permian(?) limestone beds in the partly volcanic (Carboniferous, to Lower Cretaceous) Gemuk Group of southwestern Alaska. Hornblende from gabbro that seems to intrude the Rampart volcanic rocks near the fossil locality has a K-Ar age of 205 ± 6 m. y. (Triassic). Thus, the age of the Rampart Group is considered to Permian(?). — Authors' abstract

07267 **Brown, D. A.; Dunn, J. E.; Fuqua, Ben.** Multiple-ion diffusion — [Pt.] I, Techniques for measuring and calculating apparent self-diffusion coefficients in heteroionic systems [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 5, p. 271-276, illus., tables, 1969.

This investigation was designed to integrate the quick-freeze technique for ion diffusion with two computer programs to permit the simultaneous measurement and calculation of the diffusivity of a variable number of ions in heteroionic soil systems. Kaolinitic clay was prepared so as to have the following percentage saturations of the CEC, $Sr^{2+}$65, $Mg^{2+}$15, $Rb^{+}$10, $Na^{+}$5 and $H^{+}$5. A quadruplicate radioisotope tag consisting of Sr-85, Mg-28, Rb-86, and Na-22 was used to measure the diffusivity of each ion. The complex spectra were resolved by use of Schonfeld's revised Alpha-M computer program. A probit-transformation procedure was formulated into a computer program to enable the calculation of each diffusion coefficient. These programs are described and illustrated with the diffusivity of Rb-86 in kaolinite clay. — Authors' abstract

07105 **Brune, James N.** Surface waves and crustal structure, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 230-242, illus., tables, 1969.

Shield, midcontinent, basin-range, alpine, island arc, deep-ocean basin, and midoceanic ridge are the principal types recognized in the two fundamental types of crust — oceanic and continental. Surface-wave data are not yet available for defining parameters of deep ocean trenches and continental plateau types. Relative to the two basic mantle types recognized, stable and unstable, the continental and oceanic crustal types are classed into four groups — shield and midcontinent types above a stable mantle; basin-range, alpine, and island arc types overlying an unstable mantle; deep-oceanic basin type overlying a stable mantle; midoceanic ridge type (and deep-ocean trenches) overlying an unstable mantle. — MS

**Bryant, Bruce.** *See* Lipman, Peter W. 07606

**Bryant, W. R.** *See* Santos, G. G. 07742

**Bryant, William R.** *See* Richards, Adrian F. 07467

00144 **Buchanan, Hugh; Streeter, S. Stephen.** Determination of biofacies through examination of foraminiferal wall structures — Great Bahama Bank, B. W. I. [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 13-14, 1970.

07681 **Bukry, David; Bramlette, M. N.** Some new and stratigraphically useful calcareous nannofossils of the Cenozoic: Tulane Studies Geology and Paleontology, v. 7, no. 3, p. 131-142, illus., 1969.

Fifteen new species of calcareous nannofossils of probable stratigraphic significance are described. *Cyclococcolithus macintyrei, Discoaster neohamatus, D. quintatus, Helicopontosphaera sellii, Micrantholithus procerus, Sphenolithus anarrhopus, S. neoabies, Thoracosphaera prolata, Triquetrorhabdulus inversus* are abundant with wide geographic ranges. Their usefulness in developing worldwide zonations has been evident during preliminary studies of Deep Sea Drilling Project cores; naming the taxa, therefore, is important. *Helicopontosphaera papillata, Leptodiscus larvalis, Pemma snavelyi, Quinquerhabdus colossicus, Syracosphaera formosa, S. labrosa,* presently known from restricted regions or forming a minor part of worldwide assemblages, also may prove useful because they are easily identified and seem to have restricted time ranges. — *from* Authors' abstract

**Bunce, E. T.** *See* Emery, K. O. 00099

07669 **Burkhalter, P. G.** Radioisotopic X-ray analytical techniques for gold and silver ores, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 365-379, illus., tables, discussion, 1969.

Results of an investigation to determine the sensitivity of radioisotopic, energy dispersion X-ray techniques, using semiconductor detectors for silver and gold ores, indicate that the excellent pulse resolution of the semi-portable silicon and germanium (Li-drifted) semiconductor detectors offer a rapid and sensitive method for on-line X-ray analysis of drillhole cores, ocean sediments, and ore concentrates. — VSN

07209 **Burlingame, A. L.; Haug, Patricia A.; Schnoes, Heinrich K.; Simoneit, Bernd R.** Fatty acids derived from the Green River Formation oil shale by extractions and oxidations — A review, *in* Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), p. 85-129, illus., tables, discussion, 1969.

Green River oil shale of Colorado is presumably the result of freshwater lacustrine sedimentation of algae and protozoans. Its carboxylic acids were extensively investigated to elucidate their nature and biopaleontological relationships and allow correlations with previous studies (Burlingame and Simoneit, in press) on the alkalenes isolated from this formation. The acids liberated from the mineral-kerogen matrix, after HF/HCl treatment of exhaustively extracted shale, amounted to 31.5 percent of the extract. After further separations and identifications of components by mass spectrometry, successive oxidation of the kerogen concentrate with chromic acid, for 3, 6, 15, and 24 hours, yielded substantial quantities of fatty acids, identified by the same techniques used for previous fractions. — GDC

**Burnham, C. Wayne.** *See* Holloway, John R. 07135

**Burns, Robert E.** *See* McManus, Dean A. 07437

07367 **Burrell, David C.; Wood, G. Güner.** Direct determination of zinc in seawater by atomic absorption spectrophotometry [with French and German abs.]: Anal. Chim. Acta., v. 48, no. 1, p. 45-49, table, 1969.

A direct atomic absorption spectrophotometric technique for the determination of total zinc in marine waters is described. The detection limit in a seawater matrix by this method is $2 \times 10^{-4}$ μg zinc, and 0.25-ml samples may be analyzed without any preanalysis preparation. Contamination problems are shown to be severe for zinc and initial attempts to evaluate the various chemical and physical forms in natural water samples have had limited success. — Authors' summary

00122 **Buseck, Peter R.** Tinker Toys, crystallography, and the introductory mineralogy course: Jour. Geol. Education, v. 18, no. 1 p. 26-30, illus., 1970.

By using Tinker Toys, materials that are both inexpensive and readily available, it is easy to demonstrate some fundamentals of crystallography. Planar lattices can be constructed and generated into space lattices representing all of the Bravais types. Simple as well as compound rotational operations (screw axes, rotoinversion, and rotoreflection) can be demonstrated. All of the models are sufficiently simple to construct that the students can make them. The models are easily disassembled, and the same materials can be used repeatedly. They are large enough to serve for demonstration purposes in lecture halls. — Author's abstract

07310 **Butler, J. Robert; Ragland, Paul C.** A petrochemical survey of plutonic intrusions in the Piedmont, southeastern Appalachians, U.S.A.: Contr. Mineralogy and Petrology, v. 24, no. 2, p. 164-190, illus., tables, 1969.

This is a summary of chemical and mineralogical data on intrusive igneous rocks from the Southern Appalachian orogenic belt. The exposure reaches a maximum width of about 300 km in the Carolinas and narrows along the strike to the northeast and southwest. The purpose of the paper is (1) to give the general characteristics and distribution of major groups of plutons, (2) to define the chemical trends in major elements that are exhibited by the groups, and (3) to discuss the origin of the plutons and their role in the evolution of the Southern Appalachians. We present here a first approximation of the complex intrusive history, which will undoubtedly be modified by later studies. — *from* Authors' introduction.

**Cady, Wallace M.** *See* Gilluly, James. 00102

**Cain, J. C.** *See* Zietz, Isidore. 07558

**Calkin, P. E.** *See* Borns, Harold W., Jr. 00141

07213 **Cambridge, Thomas R.** Marmaton oil production — Future potential Western Anadarko Basin: Shale Shaker, v. 20, no. 4, p. 64-71, illus., 1969.

The Pennsylvanian Marmaton Group has been an important reservoir in the Anadarko basin of Texas and Oklahoma, but recent activity has focused renewed interest on its potential. The 300-600 feet of Marmaton rocks include shelf carbonates which contain the reservoirs. The approximate shelf edge-isolith of the Marmaton unit is shown on a sketch map and the shale basin is outlined. Depositional environments are described. Most producing areas occur along the shelf edge or on the foreshelf. The geologist has to distinguish the areas of good secondary porosity development on the foreshelf; these are related to concentrated accumulations of clean limestone representing algal mounds, or areas of concentrated fractured and shattered rocks on structural nosings. Methods of isolating the areas and determining their present structural attitude are discussed; gamma-ray-neutron-acoustic logs are the most definitive tool. — ESL

**Camfield, M.** *See* Mott, R. J. 07601

07121 **Campbell, P. I.; Reid, I. A.; Shastal, J.** Glacier surveys in British Columbia: Canada Dept. Energy, Mines and Resources Inland Waters Br. Rept. Ser., no. 5, 17 p., illus., tables, 1969.

Glacier surveys are conducted in Canada as part of the systematic collection of water resource data to determine extent and pattern of a glacier's influence on surface water runoff. This report summarizes the history of glacier surveys and describes present practices both in field and laboratory; tables of results for the period of record (1964-66), some interpretation of these results, and most recent glacier maps are included. The method for determining volumetric change of glaciers makes use of the concept of completely enclosing the desired portion of the glacier by fixed coordinates, the basic equation being: area multiplied by average height equals volume. Volumetric changes are summarized for Sentinel, Sphinx, Nadahini, Kokanee, and Bugaboo Glaciers. — MCM

07288 **Canada Geological Survey.** Aeromagnetic series, Hearne Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7190, scale 1:253,440, 1969.

07289 **Canada Geological Survey.** Aeromagnetic series, Yellowknife, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7191, scale 1:253,440, 1969.

07290 **Canada Geological Survey.** Aeromagnetic series, Walmsley Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7193, scale 1:253,440, 1969.

07291 **Canada Geological Survey.** Aeromagnetic series, MacKay Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7194, scale 1:253,440, 1969.

07292 **Canada Geological Survey.** Aeromagnetic series, Carp Lakes, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7195, scale 1:253,440, 1969.

07293 **Canada Geological Survey.** Aeromagnetic series, Wecho River, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7196, scale 1:253,440, 1969.

07294 **Canada Geological Survey.** Aeromagnetic series, Marian River, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7197, scale 1:253,440, 1969.

07295 **Canada Geological Survey.** Aeromagnetic series, Aylmer Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7199, scale 1:253,440, 1969.

07296 **Canada Geological Survey.** Aeromagnetic series, Lac de Gras, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7200, scale 1:253,440, 1969.

07297 **Canada Geological Survey.** Aeromagnetic series, Winter Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7201, scale 1:253,440, 1969.

07298 **Canada Geological Survey.** Aeromagnetic series, Indin Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7202, scale 1:253,440, 1969.

07299 **Canada Geological Survey.** Aeromagnetic series, Hardisty Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7203, scale 1:253,440, 1969.

07300 **Canada Geological Survey.** Aeromagnetic series, Nose Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7205, scale 1:253,440, 1969.

07301 **Canada Geological Survey.** Aeromagnetic series, Contwoyto Lake, District of Mackenzie, Northwest Territories: Canada Geol. Survey Geophysics Paper 7206, scale 1:253,440, 1969.

**Cannon, R. T.** *See* Frarey, M. J. 07131

**Carbonell, M.** *See* Pasquera, R. 07675

00078 **Cardwell, L. E.; Benton, L. F.** Analyses of natural gases, 1968: U.S. Bur. Mines Inf. Circ. 8443, 169, p., tables, 1970.

Analyses for helium and other components are reported for 495 samples of natural gas collected as part of a continuing survey of helium resources of the free world. Samples include 444 from gas and oil wells in 20 states, 30 from wells in 3 other countries, 19 from pipelines in 4 states, and 2 from foreign pipelines. — ERL

07563 **Carpenter, John R.; Phyfer, Daniel W.** Proposed origin for the alpine type ultramafics of the Appalachians [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 261-263, 1969.

07651 **Carter, William D.** The W. L. Newman phosphate mine, Juniata County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Inf. Circ. 64, 16 p., illus., tables, 1969.

Phosphate was discovered and mined from Lower Devonian rocks at the W. L. Newman property near the end of the last century. Phosphate occurs as carbonate fluorapatite in oölitic calcareous nodules at the Onondaga Limestone-Ridgeley Sandstone contact and as veinlets and vug fillings of wavellite and crandallite in Shriver Chert. Mine workings are small and scattered over an area about 1,000× 250 feet. Of two zones mined, the upper nodular zone is thin, but exact thickness is not known; the lower secondary aluminum zone was mined by underground methods along a layer about 2.5 feet thick; as much as 20 feet below this layer, rock is mineralized by veinlets of wavellite and crandallite. Mineralized phosphate rock fragments range in grade from a trace to 26 percent $P_2O_5$; areal and stratigraphic distribution is only partly known.—*from* Author's abstract

**Casey, Richard E.** *See* Bandy, Orville L. 07641

**Catoggio, J. A.** *See* Winchester, J. W. 07671

07217 **Cattermole, J. Mark.** Geologic map of the Rapid City West quadrangle, Pennington County, South Dakota: U.S. Geol. Survey Geol. Quad. Map GQ-828, scale 1:24,000, section, text, 1969.

In the Rapid City West quadrangle, geology as it affects engineering structures does not present difficult problems where accepted architectural and engineering practices are followed. Greatest engineering hazards are in the eastern section where the western slope of the hogback consists largely of shales of the Morrison and Sundance Formations covered with colluvium which undergoes a seasonal downward creep. Engineering properties of other sections of the quadrangle are delineated. — MCM

07276 **Cavender, Ted.** An Oligocene mudminnow (Family Umbridae) from Oregon with remarks on relationships within the Esocoidei: Michigan Univ. Mus. Zoology Occasional Paper 660, 33 p., illus., 1969.

*Novumbra oregonensis*, n.sp., was found as imprints on slabs of tuffaceous lacustrine shale of the John Day Formation, with leaves of the Bridge Creek flora, at two localities in Wheeler County, Oreg. Osteology of the specimens, including two nearly complete individuals, was studied in comparison with the Olympic mudminnow *N. hubbsi*, living species of *Umbra* and *Esox*, the Alaskan blackfish *Dallia pectoralis*, *Dallia* sp. from the Miocene of Alaska, and E. Voigt's (1934) description of *Palaeoesox fritzchei* from the Eocene of Germany. *Palaeoesox* has many osteological characters considered primitive for the Esocoidei, but in a few specialized characters is closer to Umbridae than to Esocidae. In the Umbridae, *Novumbra* is intermediate between *Umbra* and *Dallia*, possibly sharing common ancestry with *Dallia*.—VMJ

07739 **Chafetz, Henry S.** Carbonates of the Lower and Middle Ordovician in central Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 58(Gen. Geology Rept.), 39 p., illus., 1969.

This investigation concerns the petrology and stratigraphic relationships of a sequence of interbedded limestone and dolomite at the contact between Lower and Middle Ordovician carbonates. Situated above the uppermost Bellefonte Dolomite of the Beekmantown Group and below the lowermost Clover Limestone of the Loysburg Formation, the Milroy Member occurs at the stratigraphic interval occu-

pied by the post-Beekmantown hiatus; up to 400 feet thick, it consists almost entirely of micritic rocks with a few sparites. Petrographic analysis indicates a very shallow marine to intertidal to supratidal environment of deposition; algal laminatioons are commonly disrupted by burrows, desiccation cracks, and clasts torn loose by water turbulence. Upper and lower contacts of the Milroy appear to be gradational with the adjacent units and very similar to them; faunal diversity increases upward. The Milroy Member, where present, must represent continuous deposition at this boundary. - *from* Author's abstract

00121 **Champlin, Robert F.** A review of the research related to ESCP: Jour. Geol. Education, v. 18, no. 1 p. 31-39, illus., 1970.

It has been five years since instructional materials produced by the Earth Science Curriculum Project first appeared in secondary schools; nine research studies and several surveys have been conducted pertaining to it. Six studies seemed to indicate that ESCP is superior to non-ESCP earth science in affecting student outcomes, and two indicate that the combination of right curriculum with right teacher was an important factor. Analyses of the content of Unit 4, comparing it to that of college astronomy courses, indicate it gives an adequate background for teachers of ESCP. Although the reading level and sophistication were found too difficult for ninth graders, this unit was a favorite with most students. Questions are raised for further educational research through the aid of an instructional sequence model. — *from* Author's abstract

07347 **Chan, Siew Hung.** A theoretical study on the interpretation of resistivity sounding data measured by the Wenner electrode system [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2261B, 1969.

00115 **Chang, Fred F. M.** Ripple concentration and friction factor: Am. Soc. Civil Engineers Proc., v. 96, paper 7067, Jour. Hydraulics Div., no. HY 2, p. 417-430, illus., table, 1970.

Flow over ripples in alluvial channels is essentially the same as the flow over rigid roughness elements, the main difference lying only in the shapes of the ripples and roughness elements. The total friction factor is the summation of grain-roughness friction factor and form-roughness friction factor. Nikuradse's formula for grain-roughness friction factor is found to be satisfactory in determining the value of grain-roughness friction factor for the flow in alluvial channels. The form-roughness friction factor is proportional to the "exposure parameter" and inversely proportional to mean relative height of the ripples. And, it is also proportional to the coefficient of expansion loss, which is found to be a function of the mean relative heights of the ripples. — Author's abstract

07564 **Chang, Luke L. Y.** Subsolidus phase relations in binary carbonate systems involving aragonite [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 263-264, 1969.

**Chapman, R. M.** *See* Brosgé, W. P. 07721

**Chapple, William M.** *See* Spang, John H. 07499

**Charlesworth, H. A. K.** *See* Robinson, J. E. 07591

07157 **Charm, W. B.; Nesteroff, W. D.; Valdes, Sylvia.** Detailed stratigraphic description of the JOIDES cores on the continental margin off Florida: U.S. Geol. Survey Prof. Paper 581-D, p. D1-D13, illus., tables, 1969.

Cores, totaling 513 m, were recovered from six holes drilled into the continental shelf, Florida-Hatteras slope, and Blake Plateau off eastern Florida. From every 76 cm of core, a sample was taken for petrologic examination and for determination of calcium carbonate and percent coarser than 62 microns. Limestone, sands, silts, and clays, presumably of shallow-water origin, make up Eocene and younger sediments beneath the continental shelf east of Jacksonville. Upper Eocene and Oligocene sedi-

ments thicken slightly toward the edge of the shelf. Alternating layers of clay and limestone were deposited on the Florida-Hatteras slope during Eocene and Oligocene. Since Miocene (Miocene sediments are absent), they have been covered by clay that grades into sand. Foraminiferal oozes and silts have prevailed since Eocene on Blake Plateau. — WBC

00209 **Chase, C. G.; Menard, H. W.; Larson, R. L.; Sharman, G. F., 3d.; Smith, S. M.** History of sea-floor spreading west of Baja California: Geol. Soc. America Bull, v. 81, no. 2, p. 491-497, illus., 1970.

Magnetic anomalies in the standard sequence of ages from 25 m.y. to 4 or 5 m.y. B.P. are correlated from north to south in an area immediately west of southern Baja California. Interpreting patterns in light of assumptions of plate tectonics suggests the following evolution of the East Pacific Rise approaching North America. Before 20 m.y. B.P., two Pacific Ocean plates were spreading east-west from each other. By 15 m.y. B.P. the ridge had split into a 'Y' of three ridges. Three Pacific blocks were present, the southern two still spreading east-west; the northern one inside the arms of the 'Y' had a northward component of motion. After 12 m.y. B.P., the system reorganized into a single ridge spreading NW-SE. Since 5 m.y. ago the present system has prevailed, with remnants of the old Eastern Pacific block fused to the continent north of the Rivera Fracture Zone. The Western Pacific block has spread to the northwest, opening the Gulf of California, and carrying southwestern California and Baja California with it.—*from* Author's abstract

00145 **Cheney, E. S.; Oliphant, J. D.; Jones, M. B.** Geology of the Blue Hill-Castine mining district, southwestern Hancock County, Maine [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 14, 1970.

00113 **Chitale, Shrikrishna V.** River metamorphosis — Discussion [of paper 6352 by S. A. Schumm, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 2, p. 586-688, 1970.

Chitale is in general agreement with the interdependence of the various river characteristics presented (ibid., v. 95, no. HY 1, p. 255-273, 1969) but suggests that it would be useful to add meander width. Characteristics which are ordinarily associated could be grouped in two categories. The question is raised as to whether the perimeter of the channels means the banks alone, or banks and bed. Data in respect to $Qt$ should be included in Appendix I, and it would be more useful if some measure of bed material size were also added. Effects of engineering works on river discharge and sediment load are discussed. — ESL

**Chmelik, Frank B.** *See* Bouma, Arnold H. 07562

**Christie, R. L.** *See* Nassichuk, W. W. 07598

**Church, W. R.** *See* Stevens, R. K. 07507

07359 **Clausen, E. N.** Evolution of badland caves [abs.]: North Dakota Acad. Sci. Proc. 1969, v. 23, p. 3, 1969.

**Clayton, Lee.** *See* Harrison, Samuel S. 07303

**Clemons, Russell E.** *See* Long, Leon E. 07420

07152 **Cleveland, John H.; Tiefel, Carol F.** Gypsum resources of the midwestern United States [abs.]: Indiana Acad. Sci. Proc. 1968, v. 78, p. 315, 1969.

00146 **Coates, Donald R.** Topographic basins in the uplands of the Appalachian Plateau [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 15, 1970.

00147 **Coates, H. J.; Kennedy, M. J.** Major recumbent folds between Ming's Bight and Grand Cove, Burlington Peninsula, Newfoundland [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 15, 1970.

07348 **Cochran, Michael David.** Long period leaking modes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2261B, 1969.

07366 **Colbert, Edwin H.** Evolution of the vertebrates — A history of the backboned animals through time (2d edition): New York and London, John Wiley and Sons, 535 p., illus., 1969; originally published 1955.

New knowledge in the field has led to the revision and augmentation of the first edition, the addition of original illustrations, and a compromise classification of the vertebrates, based on differing views of authorities. Chapter headings are: introduction, jawless vertebrates, acanthodians and placoderms, success of fishes, from water to land, early vertebrate faunas, amphibians, advent of reptiles, mammal-like reptiles, conquest of the land, early ruling reptiles, marine reptiles, flying reptiles and birds, triumph of the dinosaurs, surviving reptiles, beginning of mammals, marsupials, placentals, diverging placentals, evolution of primates, rodents and rabbits, cetaceans, creodonts and carnivores, ancient hoofed mammals, South American ungulates, perissodactyls, artiodactyls, elephants and their kin, and ages of mammals. A classified bibliography and a subject index are appended. — MCM

07585 **Cole, A. J.** An iterative approach to the fitting of trend surfaces: Kansas Geol. Survey Computer Contr. 37, 27 p., illus., 1969.

The method described is a further development on that in Cole, Jordan, and Merriam, 1967. The data used are the same as that of McIntyre, 1967. The trend-surface analysis includes a mapping technique which plots initial polynomial overall fit, iterative final fit, and difference map. The mathematical method used is an iterative quadratic bump and smoothing technique on a polynomial least-square base. — ESL

**Colquhoun, D. J.** *See* Pierce, J. W. 07450

**Colton, G. W.** *See* Bailey, N. G. 07621

**Conklin, Nancy M.** *See* Young, E. J. 07724

07197 **Cook, David.** Sonolite, alleghanyite and leucophoenicite from New Jersey: Am. Mineralogist, v. 54, nos. 9-10, p. 1392-1398, tables, 1969.

Sonolite and alleghanyite, the manganese analogues of clinohumite and chondrodite respectively, are reported from Franklin and Sterling Hill, N. J. Sonolite locally may have been an ore mineral at Franklin. The original leucophoenicite of Penfield and Warren (1899) is shown to be a valid species, identical with the material of Palache (1910), but the later studies of this mineral by Palache (1928, 1935) and Moore (1967) are composite descriptions of leucophoenicite, sonolite and alleghanyite. Some still undescribed chemical variants of minerals in the chondrodite and olivine groups also have been recognized together with the Mn analogue of humite. Some of these minerals have been confused with leucophoenicite. — Author's abstract

**Cook, M. G.** *See* Weed, S. B. 07646

**Cooper, Hilton H., Jr.** *See* Pinder, George F. 07451

00134 **Cox, Dennis P.** Lead-zinc-silver deposits related to the White Mountain Plutonic Series in New Hampshire and Maine: U.S. Geol. Survey Bull. 1312-D, p. D1-D18, illus., 1970.

Silver-bearing galena and sphalerite occur in mesothermal and epithermal fault-breccia veins in eastern New Hampshire and southwestern Maine. The veins are in a north-trending belt that coincides with the belt of plutons of the White Mountain Plutonic Series of Triassic or Jurassic age. The Conway Granite, the youngest formation in the series, is proposed as the source of the deposits. — DPC

**Cox, Doak C.** *See* VanAlstine, Ralph E. 07595

07181 **Crandell, Dwight R.** Surficial geology of Mount Rainier National Park, Washington: U.S. Geol. Survey Bull. 1288, 41 p., illus., table, geol. map, 1969.

Surficial deposits of Mt. Rainier National Park record a complex series of recent geologic events. Glaciers formed oldest deposits early, perhaps before the volcano began to develop; huge glaciers again blanketed most of the park twice during the last 40,000-50,000 yr. The last major glaciation ended about 10,000 yr ago; within the last few thousand years glaciers have experienced renewed growth at least twice. Mt. Rainier has erupted repeatedly since the last major glaciation, but most activity has been feeble compared with cataclysmic eruptions that built the main cone. Production of new lava and pumice has not kept pace with piecemeal destruction of the volcano by glacial erosion and repeated landslides; at least two mudflows were large enough to reach far down valleys and bury parts of the Puget Sound lowland. It is likely that geologic events will recur. Surficial deposits shown on the geologic map are described. — *from* Author's summary

**Creager, Joe S.** *See* Sternberg, Richard W. 07107

00116 **Crickmore, Maurice J.** Effect of flume width on bed-form characteristics: Am. Soc. Civil Engineers Proc., v. 96, paper 7077, Jour. Hydraulics Div., no. HY 2, p. 473-496, illus., tables, 1970.

Dimensions of bedforms developed in laboratory channels are a function of channel width. A 10 to 30 percent reduction is observed in size of irregularities displayed by a self-formed bed of 0.6 mm sand in a channel 1.5 ft wide, compared to that in a 5.0 ft wide channel, under similar discharge conditions. It is important to standardize parameters for the dimensional description of bedform profile, and adoption of significant form height and average distance between alternate zero-crossings is advised. Distribution of bed elevations conforms with accepted theoretical distributions for water waves provided allowance is made for the greater spectral width values that characterize bedform profiles. Because sediment movement occurs as surface creep in this case, the transport, calculated from bedform celerity and a form height parameter proposed by Mercer, is in close agreement with measured total transport. — *from Author's abstract*

07186 **Cronan, D. S.** Average abundances of Mn, Fe, Ni, Co, Pb, Mo, V, Cr, Ti and P in Pacific pelagic clays: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1562-1565, tables, 1969.

New analytical data on twenty-six Pacific pelagic clay samples are presented. These data together with previously published analyses have been used to calculate the average abundances of some elements in Pacific clay sediments. — Author's abstract

00148 **Crosby, Percy.** Electron probe microanalysis of iridescent intermediate plagioclase and coexisting feldspars from Adirondack anorthosite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 16, 1970.

**Curray, J. R.** *See* Normark, W. R. 07703

07252 **Curry, Kenneth J.; Grimes, David J.** A method for analyzing geologic material by a new mobile direct-reading spectrometer [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 672, 1969.

**Czamanske, Gerald K.** *See* Rye, Robert O. 07476

**Dachille, Frank.** *See* Gigl, Paul D. 00192

07205 **Dachille, Frank; Simons, P. Y.; Roy, Rustum.** Pressure-temperature studies of anatase, brookite, rutile and $TiO_2$(II) — A reply [to discussion of 1968 paper by J. C. Jamieson and B. Olinger, 1969]: Am. Mineralogist, v. 54, nos. 9-10, p. 1481-1482, 1969.

It is agreed upon generally that rutile is the only stable phase at or near one atmosphere. Direct reversible phase equilibrium methods have so far failed to give definitive solutions to equilibrium among the various phases. It was stated in the 1968 paper discussed by Jamieson and Olinger (ibid., p. 1477-1481) and several others, that there was insufficient evidence for any statement on equilibrium, but unfortu-

nately one or two incorrect statements crept in. The discussers have provided a valuable comment on a possible $TiO_2$ *stable* equilibrium diagram. — ESL

07349 **Dahlen, Francis Anthony, Jr.** The normal modes of a rotating elliptical Earth [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2261B-2262B, 1969.

07145 **Daily, Fay Kenoyer.** Some late glacial charophytes compared to modern species: Indiana Acad. Sci. Proc. 1968, v. 78, p. 406-412, illus., table, 1969.

Of the fossil fructifications from New York referred to the modern taxa, *Chara sejuncta* and *Tolypella glomerata*, the latter displayed a triply-segmented basal plate on the oospore, while a previously reported species, undoubtedly *T. proliferata*, had an undivided basal plate. In comparing some modern specimens to the above, it was found that Tolypellas of the section Conoideae to which *T. proliferata* belongs had an undivided basal plate similar to that in the Chareae. Members of the section Allantoideae had doubly or triply-segmented basal plates as in *Nitella*. Some well-developed hard limeshells were discovered in a collection of *T. prolifera* from Indiana. Calcium deposits inside the spiral cells found in oogonia and other members of the Conoideae were not found in Allantoideae or in *Nitella*. — *from* Author's abstract

07177 **Dalrymple, G. Brent; Lanphere, Marvin A.** Potassium-argon dating — Principles, techniques and applications to geochronology: San Francisco, Calif., W. H. Freeman and Co., 258 p., illus., tables, 1969.

The K-Ar method, first suggested about 30 years ago, has been in routine use in geology for more than a decade. This book, an outgrowth of a U.S. Geological Survey pamphlet, is an introduction to the principles, techniques, and applications of the method. Chapter headings are: atoms, elements, and isotopes; radioactivity; isotopes of potassium and argon; the potassium-argon clock, how it works; argon measurements; potassium measurement; accuracy and precision; extraneous argon; argon loss; what can be dated; and putting the clock to work. A 14-page bibliography and an index are included. Appendixes contain: constants and conversion factors; nomograms for K-Ar age calculations, sample K-Ar age calculation, and derivations of formulae. — MCM

07362 **d'Anglejan, B. F.** Preliminary observations on suspended matter in the Gulf of St. Lawrence: Maritime Sediments, v. 5, no. 1, p. 15-18, illus., 1969.

Much work remains to be done before one arrives at a quantitative understanding of the suspended flux through the Gulf of St. Lawrence. These preliminary observations indicate, however, the existing ranges of concentrations and underline the role played by the estuarine-type circulation in regulating the exchange between the Gulf and the open ocean. Although the values observed are low, the abundance of both fine muds in recent Gulf sediments and chlorite-rich clays in areas of the Atlantic Basin south-east of Newfoundland indicate the possible importance of the suspended transport from the St. Lawrence drainage system, and invite further studies. The significance of the upstream transport in the deep water also requires a closer examination. — Author's conclusion

**Daniels, R. B.** *See* Steele, Forrest. 07727

07665 **Darnley, A. G.; Bristow, Q.; Donhoffer, D. K.** Airborne gamma-ray spectrometer experiments over the Canadian Shield, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 163-186, illus., tables, discussion, 1969.

A high sensitivity spectrometer designed for radiometric mapping of the Canadian Shield is described. Experiments were undertaken in the Bancroft and Elliot Lake areas of Ontario to determine the system parameters. An experimental spectrometer, employing three 5 × 5 in. diameter NaI(Tl) detectors to record the full gamma-spectrum in real time on magnetic tape was flown in a helicopter at 25 mph. Spectra

revealed the optimum spectral window widths for measuring the relative abundance of K, U, and Th. Recorded data were processed through a PDP-9 computer to correct for dead time, Compton scattering and deviations from constant terrain clearance. On the basis of results a more sensitive airborne system was constructed and installed on a twin-engined aircraft. — VSN

07183 **Dasch, E. Julius.** Strontium isotopes in weathering profiles, deep-sea sediments, and sedimentary rocks: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1521-1552, illus., tables, 1969.

Modifications in the Rb-Sr-Sr isotope system during low-temperature geologic processes have been determined for major lithic units. Rb-Sr ratios in basalt and granite increase markedly during weathering, but Sr isotope composition is not altered significantly in many profiles. Deposition of aluminosilicate detritus in the marine environment may result in a further increase of Rb-Sr ratios for the detritus, owing to Rb fixation. Since Sr in even the finest fraction of aluminosilicates deposited in the ocean does not equilibrate with marine Sr, the isotopic composition of Sr in deep-sea sediments may be used as an indicator of geologic provenance. The lack of Sr isotope equilibration during low-temperature processes places constraints on the dating of sediments and sedimentary rocks by the Rb-Sr method. — GV

**Daughtry, Kenneth L.** *See* Jonson, David C. 07394

**Davey, C. B.** *See* Weed, S. B. 07646

**Davidson, Donald A.** *See* Jonson, David C. 07394

07593 **Davis, John C.** Distribution of hydrocarbons in three dimensions, *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 34-40, illus., 1969.

Areal distribution of hydrocarbons and other components of rock bodies have been mapped to relate their distribution to economic concentrations. They are dispersed three-dimensionally and vertical distribution may be as important as areal. Distribution patterns in three dimensions are difficult to portray, but response surface analysis provides a rapid method. The variable of interest, as percent organic carbon, is regressed on a linear combination of three geographic axes. The resulting linear equation is a least-squares expression of the relation between dependent variable and spatial coordinates. A polynomial expansion of the linear equation provides a better representation. Measurements of organic carbon from Mowry Shale in Wyoming illustrate effects that can be obtained using different linear models. Relations between distribution patterns and location of fields can be shown graphically on models. — *from* Author's abstract

07274 **Davis, L. G.; Turner, A. K.; Melhorn, W. N.** Analysis of ground water use, replenishment, and aquifer characteristics in Bartholomew County, Indiana: Purdue Univ. Water Resources Research Center Tech. Rept. 3, 83 p., illus., tables, 1969.

Trend surfaces can model water-table geometries from ground-water levels more quickly than analog models, and trend-surface analysis allows validity of models to be checked statistically and graphically. An aquifer in glacial outwash was studied by trend-surface techniques while an analog study was done by the U.S. Geological Survey. Computer-generated trend and residual maps were produced; comparisons used cross-correlation procedures. Conclusions reached were that: water-table geometry went through a cyclic change reflecting seasonal changes; map comparison suggests that the ground-water regime reacts to these changes within a month; graphical and statistical methods are important in evaluating the meaning of any trend surface; under favorable conditions trend surfaces can help identify influent and effluent streams, and influence of buried drainage patterns; results of trend analysis agree with analog models. — *from* Authors' abstract

**Dawson, T. A.** *See* Patton, John B. 07112

**De Pablo, L.** *See* Pasquera, R. 07675

07565 **Deffeyes, Kenneth S.** Electron macroprobe for logging deep-sea cores [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 264, 1969.

07080 **Dehlinger, Peter.** Gravity and its relation to topography and geology in the Pacific Ocean, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 352-363, illus., 1969.

Near-zero free-air anomalies characterize the areas off the coasts of northern California and Oregon and, in general, are correlative with local, but not regional, topography. Large anomalies near the islands and seamounts along the Hawaiian archipelago are attributed to the absence of isostatic equilibrium, whereas those in the eastern part of the Mendocino escarpment area off California, apparently nearly in isostatic equilibrium, are attributed to topography and to complex geologic variations that extend into the upper mantle. The anomalies are affected by both bottom topography and geologic conditions, but neither local nor regional topography is a reliable guide for their estimation, even in areas in which the extent of isostatic equilibrium has been determined. — MS

07304 **Delke, Ruth G.** Relations of jointing to orientation of solution cavities in limestones of central Pennsylvania: Am. Jour. Sci., v. 267, no. 10, p. 1230-1248, illus., tables, 1969.

Twenty-six caves in central Pennsylvania were divided into passage segments inferred to have formed along the strike of fracture planes. For each cave passage, bearings weighted by footage were used to calculate an average passage orientation. Fractures measured at outcrops near the caves were classed by strike of subparallel sets which were cumulated by frequency for preferred orientations. Average passage orientation compared with orientation of fracture frequency was significant to the 95 percent level. Thus, caves develop more footage parallel to the strike of the more abundant fractures. Solution passages can therefore be used as one determinant of the local fracture system, and a selective solution process may be related to the mechanical origin of the fractures as well as their frequency. — *from* Author's abstract

**Dellwig, Louis F.** *See* MacDonald Harold C. 07426

**Dellwig, Louis F.** *See* Wing, Richard S. 07546

07238 **Denton, George H.; Armstrong, Richard L.** Miocene-Pliocene glaciations in southern Alaska: Am. Jour. Sci., v. 267, no. 10, p. 1121-1142, illus., tables, 1969.

Interbedded till, fluvial units, and lava flows, tilted and faulted into discrete blocks, form several foothills flanking the upper White River valley in the Wrangell Mts. One block has 12 tillites; others exhibit from one to five. K-Ar dates on the interbedded lavas show many of the tillites to be 9 to 10 m.y. old; one is 3.6 m.y. old; and two are between 8.8 and 2.7 m.y. old. At least four Pleistocene till sheets overlie the tillite sections; K-Ar dates show all four postdate 2.7 m.y., and radiocarbon dates show the youngest corresponds in part to Kluane glaciation. Two of the other three are more than 47,000 years old. The record from southern Alaska and elsewhere of continuous glaciation through a large part of the Cenozoic emphasizes that a definition of the Pliocene-Pleistocene boundary based on climatic cooling and glaciation no longer is feasible. — *from* Authors' abstract

07361 **Denton, George H.; Stuiver, Minze.** Late Pleistocene glacial stratigraphy and chronology, northeastern St. Elias Mts., *in* Icefield Ranges Research Project scientific results, V. 1 (V.C.Bushnell and R.H.Ragle, editors): New York, Am.Geog.Soc.,and Montreal, Quebec, Arctic Inst.North America, p.197-217, illus., tables, reprinted 1969; originally published 1967.

This paper was published originally in Geol. Soc. America Bull., v. 78, no. 4, p. 485-510, 1967; *see* Abstracts of North American Geology, September 1967.

**Denton, George H.** *See* Stuiver, Minze. 07512

**Desborough, George A.** *See* Leonard, B. F. 07191

**Deshpande, K. B.** *See* Gast, R. G. 07645

00132 **deWitt, Wallace, Jr.** Age of the Bedford Shale, Berea Sandstone, and Sunbury Shale in the Appalachian and Michigan basins: U.S. Geol. Survey Bull. 1294-G, p. G1-G11, illus., 1970.

Excepting a basal fossiliferous zone about 1 meter thick, the Bedford Shale and suprajacent Berea Sandstone overlie the Cussewago (Murrysville) Sandstone in western Pennsylvania and contiguous eastern Ohio. The Cussewago (Murrysville) contains an *Adiantites* flora in central Pennsylvania indicating an Early Mississippian (Kinderhook) age for this sandstone. The black *Siphonodella*-bearing Sunbury Shale of Kinderhook age overlies the Berea Sandstone in the northwestern Appalachian basin and the eastern Michigan basin. Consequently, the Berea Sandstone and all but the basal few feet of the Bedford Shale are of Early Mississippian (Kinderhook) age in both basins. — WdeW

07315 **Dezfulian, Houshang.** Seismic response of soil deposits underlain by inclined boundaries [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2154B, 1969.

07369 **Dibaj, Mostafa.** Non-linear seismic response of earth structures [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2154B, 1969.

**Dilcher, D. L.** *See* Dolph, G. E. 07150

00096 **Dillon, William P.** Submergence effects on a Rhode Island barrier and lagoon and inferences on migration of barriers: Jour. Geology, v. 78, no. 1, p. 94-106, illus., 1970.

The Charlestown-Green Hill barrier beach-lagoon complex lies along Rhode Island's south shore. The barrier beach and tidal delta sands, lagoonal fine sediments, and lag deposits, which are rarely more than a few meters thick, are derived mainly from reworking of glacial sediments that have been deposited on a base of glacial sediments. Though formed at a lower sea level, the barrier bar's landward migration and encroachment across the lagoon has been and is impeded by its low profile and by lack of supply of sediment from the sea or the land. — *from* Author's abstract.

**Doan, Arthur S.** *See* Walter, Louis S. 07535

07188 **Dodd, Charles G.; Glen, G. L.** A survey of chemical bonding in silicate minerals by X-ray emission spectroscopy: Am. Mineralogist, v. 54, nos. 9-10, p. 1299-1311, illus., table, 1969.

A survey has been made of the K$\beta$-band X-ray spectra of crystalline silicates having particular significance as rock-forming minerals. These include representative orthosilicates, pyrosilicates, and framework and chain silicates. Aluminum K$\beta$-band spectra of tetrahedrally coordinated Al proxying for Si, in both ordered and disordered structures, were found to be similar to the Si K$\beta$-band spectra of the same minerals. The Si-O bond strengths were found to vary as a function of the apparent degree of orbital overlap, as determined by known Si-O-M bond angles, where M is another cation. Decrements in Si-O bond strengths relative to $SiO_2$ were measured in terms of electron volts or kilocalories per mole. — Authors' abstract

**Dodd, J. Robert.** *See* Siemers, Charles T. 07490

07231 **Dodge, Charles F.** Geology, the third culture: Jour. Geol. Education, v. 17, no. 5, p. 196-197, 1969.

Environments, products of geologic processes, are the dominant control on evolution. Effects of the trend of mountain ranges on man in Asia and North America are examples. It is the responsibility of geologists to explain the physical environment from an overall view. — ESL

**Dodge, F. C. W.** *See* Bateman, P. C. 00211

07566 **Dodge, F. C. W.; Ross, D. C.; Wollenberg, H. A.; Smith, A. R.** Content of heat-producing elements in plutonic rocks of the Salinian block, California Coast Ranges [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 266-268, illus., table, 1969.

**Dodge, F. C. W.** *See* Gottfried, David. 07572

**Dollase, W. A.** *See* Hariya, Y. 07200

07567 **Dollase, W. A.; Hollister, L. S.** X-ray evidence of ordering differences between sectors of a single staurolite crystal [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 268-270, table, 1969.

07150 **Dolph, G. E.; Dilcher, D. L.** An Eocene discovery of *Dendropanax* [abs.]: Indiana Acad. Sci. Proc. 1968, v. 78, p. 115-116, 1969.

07316 **Dominick, Wayne Paul.** Mechanical model analysis of the interaction of soil and framed structures [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2154B-2155B, 1969.

00123 **Donath, Fred A.** Rock deformation apparatus and experiments for dynamic structural geology: Jour. Geol. Education, v. 18, no. 1 p. 3-12, illus., tables, 1970.

Demonstration in the classroom or laboratory of the behavior of rock subjected to differential stress under high confining pressure provides the geologist with insights into natural geologic deformation that are difficult to obtain in any other way. This paper describes an apparatus of unique design that is simple enough for demonstration purposes or student operation, yet is equally well suited for research. The design provides for essentially maintenance-free operation and eliminates the need for bulky and expensive ancillary equipment normally required for triaxial testing. Three sets of experiments are outlined that demonstrate the effects of rock type, confining pressure, and planar anisotropy on strength, ductility, and the mode of deformation. These can be carried out with the apparatus utilizing readily-available materials. — Author's abstract

07264 **Doner, H. E.; Mortland, M. M.** Intermolecular interaction in montmorillonites — NH-CO systems [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 5, p. 265-270, illus., tables, 1969.

Mechanism of reaction between cationic organic molecules in montmorillonites and organic compounds with carbonyl groups was investigated with dialkyl amides. Their electronegativity or basicity was linearly related to C-O stretching frequency after adsorption on trimethyl-ammonium-montmorillonite. Hydrogen bonded through oxygen of the carbonyls to hydrogen of the trimethylammonium ion, respective changes in the C-O and N-H stretching frequencies were directly related to bond strength; only after adsorption of amides the size of N, N-diethylacetamide or larger, did the (001) spacing, 12.9 A, change. Their adsorption on tetramethylammonium-montmorillonite was less energetic; its (001) spacing, 13.8 A, remained the same. These cations are not found in soils and sediments, but used as model systems they show possible importance of hydrogen bonding between natural organic molecules and carbonyl compounds in pesticides on clay surfaces. — GDC

07663 **Donhoffer, D. K.** Determination of ore concentration in exploration holes by the gamma-ray backscattering technique, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 23-35, illus., tables, 1969.

The gamma-ray backscattering technique applied to determination of zinc concentration in exploration holes in a zinc-lead mine allowed calculation of calibration curves for different sources and source detector geometries. Co-60, Cs-137 and Se-75 were used as gamma-sources, the best results being obtained using Co-137. Different probe lengths were investigated, and measurements were carried out with optimized probe in drill holes, for which zinc concentration had been determined by core sampling and chemical analyses. Backscattering measurements were evaluated by

calculated calibration curves; good agreement was obtained with chemical drill analyses. Mean deviation for a typical borehole of 50 m length was 1 percent. — *from* Author's abstract

**Donhoffer, D. K.** *See* Darnley, A. G. 07665

07071 **Dorman, James.** Seismic surface-wave data on the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 257-265, illus., 1969.

A qualitative comparison of important upper mantle effects is drawn from selected phase-velocity dispersion data, which serve as a basis for discussion of differences in gross geology and physical conditions of the crust and upper mantle. Oceanic dispersion values for the Pacific region exhibit a small spread, suggesting striking lateral uniformity of the crust and mantle in deep Pacific basins. The persistent spread of continental dispersion values out to long periods is interpreted to mean that the strong contrasts in surface conditions between stable and unstable continental areas are reflected at great depth by similarly striking contrasts in physical properties. Interpretation in terms of mantle shear results in postulating that the principal regional differences are not confined to the crust but extend through a much thicker zone, to a depth of a few hundred kilometers, for which the term active geologic layer is warranted. — MS

**Dovala, D. L.** *See* Brandt, W. W. 07256

07568 **Drafall, Larry E.; Koucky, Frank L.** Differential thermal analysis of the lead sulfantimonides [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 270-271, illus., 1969.

**Drahovzal, James A.** *See* Neathery, Thornton L. 07696

07054 **Drake, Charles L.** Continental margins, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 549-556, illus., 1969.

Continental margins of the Atlantic Ocean have been little affected by tectonic activity since the end of the Paleozoic and differ considerably in character from the margins of the Pacific, where the transition zone is marked by extensive areas whose crust is neither continental nor oceanic. Differences in structure may be interpreted as due to equalization of continental drift in the Atlantic basin by crustal material produced during ocean-floor spreading and the elimination of excess crust created in mid-oceanic ridges of the Pacific basin, possibly by some downward convective, drag, or thrusting process. Mechanisms are not yet fully known, and considerable further work is needed to substantiate generalizations based on study of a few areas. — MS

**Drew, Lawrence J.** *See* Parizek, Richard R. 07714

00149 **Driver, Edgar S.** Review of GULFREX program for marine exploration [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 16, 1970.

07254 **Dryer, H. T.; Johnston, F.** X-ray analysis of alumina and fluorspar [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 676, 1969.

07604 **Duffield, Wendell A.** Concentric structure in elongate pillows, Amador County, California, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D19-D25, illus., 1969.

A porphyritic pillow lava crops out in the pre-Cenozoic bedrock complex of the Sierra Nevada, western foothills, Amador County, Calif; its form and structures suggest the pillows are interconnected and formed on a slope when a magma-crystal mixture flowed into and then through them as local rupture of chilled skins gave rise to new pillows. Field evidence that suggests this mode of formation is the pillows are elon-

gate, their long axes are alined, and large tabular phenocrysts are uniformly parallel to pillow walls from skins to cores. Both concentric structure and calculations which describe flow through a cylindrical conduit argue that movement of material through the pillows was effectively laminar. This mode of formation for pillows is generally the same as that proposed by J.V. Lewis in 1914 and J.G. Jones in 1968; the concentric structures within pillows add new support for their idea. — *from* Author's abstract

07741 **Duftschmid, K. E.** A versatile field instrument for X-ray fluorescence analysis, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 325-342, illus., discussion, 1969.

A portable X-ray fluorescence analyzer has been developed consisting essentially of an $Xe/CH_4$ proportional counter probe and an electronic unit with single-channel analyzer, binary scaler, digital-to-analog converter with meter-readout and an automatic gain control circuitry. The radioactive source, Am-241, is suitable for excitation of fluorescence X-rays in a wide range of elements, and is simultaneously used for the AGC operation by measuring a small fraction of the Am-241 gamma radiation directly incident through a small collimator hole into the detector. Several fixed single-channel windows selected by a rotary switch can be set for various elements of interest. Design features of the instrument make it extremely suitable for prospecting and mining applications. — *from* Authors' abstract

07172 **Dunbar, Carl O.; Waagé, Karl M.** Historical geology (3d edition): New York and London, John Wiley and Sons, 556 p., illus., tables, 1969; originally published 1949.

This volume, a successor to Dunbar's *Historical geology*, preserves the same general framework, but nearly all the text has been rewritten and two new chapters have been added. Intended primarily for American students, the book gives prominence to the North American continent. Part 1, prologue, contains chapters on records in stone, span of geologic time, living record of the dead, restless crust, cosmic history of Earth, constant change of living things, and Cryptozoic era. Parts 2 and 3 deal with the Paleozoic and Mesozoic worlds, respectively. Part 4, the modern world unfolds, contains chapters on the part title, ice sculptures the final scene, mammals inherit the Earth, coming of Man, and epilogue. References are listed at the end of each chapter. An introduction to animals and plants and an index are appended. — MCM

**Duncan, A. R.** *See* Taylor, S. R. 07364

**Duncan, John R.** *See* Fowler, Gerald A. 07571

**Dunn, J. E.** *See* Brown, D. A. 07267

07236 **Durrant, Stephen D.** Eugene Raymond Hall — Biography and bibliography, *in* Contributions in mammalogy — A volume honoring Prof. E. Raymond Hall: Kansas Univ. Mus. Nat. History Misc. Pub. 51, p. 8-24, portrait, 1969.

**Duryea, Richard D.** *See* MacNish, Robert D. 07242

**Dutro, J. Thomas, Jr.** *See* Patton, William W., Jr. 07615

**Eckart, D. W.** *See* Kohn, J. A. 07408

**Edenharter, A.** *See* Nowacki, W. 07704

07652 **Edgerton, Curtis D.** Peat bog investigations in northeastern Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Circ. 65, 53 p., illus., tables, 1969.

The U.S. Bureau of Mines conducted this investigation to locate unexploited peat bogs in northeastern Pennsylvania, to determine their characteristics and harvestable reserves, and to suggest suitable methods of harvesting and processing the peat. Nine bogs, each containing harvestable reserves in excess of 100,000 short tons, were ex-

plored. Examination of samples indicated most peat was of the reed-sedge variety, although some peat humus and small amounts of sphagnum-moss peat were found. The study revealed that the bogs could be suitably harvested and the peat processed by readily available commercial earthmoving and farming equipment. Peat produced in northeastern Pennsylvania should find ready acceptance in local and Atlantic Seaboard markets. — *from* Author's abstract

**Ehrlich, Robert.** *See* Hoffman, James I. 07133

00112 **Einstein, H. A.** Deposition of suspended particles in a gravel bed — Closure [to discussion of paper 6039, 1968]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Hydraulics Div., no. HY 2, p. 581-582, 1970.

In reply to Yao's rather important point that the quartz particles in city water have a tendency to be negatively charged, and therefore repulse each other, Einstein states that if the original paper (ibid., v. 94, no. HY 5, p. 1197-1205, 1968) mentioned that surface forces were negligible, it was meant to say that submerged weight was sufficient to overcome attraction between particles and gravel. The author appreciates Owen's interest in applying Camp's theory to the study and pointing out some fine points of the data, which were not needed for the purposes of the original study. Very fine particles showing opposite surface charges might deposit in the top layers of a gravel bed making it impervious to the silt described. — ESL

07569 **Elders, Wilfred A.** Zoned alkali feldspars from the Lincoln sill syenite, Maine [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 271-273, 1969.

00099 **Emery, K. O.; Uchupi, Elazar; Phillips, J. D.; Bowin, C. O.; Bunce, E. T.; Knott, S. T.** Continental rise off eastern North America: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 1, p. 44-108, illus., table, 1970.

North America separated from Europe-Africa in Early Permian time. The rift zone, conveyed westward, was preserved as a ridge of crystalline rock along the base of the present continental slope. This ridge trapped land-derived Mesozoic sediments and only pelagic silts and clays reached the Mesozoic abyssal plain. Periodically during Late Cretaceous-middle Eocene time thick layers of chert accumulated on the abyssal plain (producing an acoustic reflector known as Horizon A). By mid-Eocene time sediments had filled in behind the ridge-trap, and were prograding eastward to begin building (on Horizon A) the present continental rise. In places, the present rise is more than 6 km thick and half of its 3 million km³ volume consists of strata so contorted as to indicate emplacement by large-scale sliding and slumping. Such (en masse) emplacements of interbedded sandy turbidites and organic-rich silts and clays constitute attractive (but untested) petroleum plays—pending geologic and legal definitions of the edge of the continent.—BHK

00150 **Emrich, Grover H.; Merritt, Gary L.; Rhindress, Richard C.** Geocriteria for solid waste disposal sites [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 17, 1970.

07732 **Enfield, C. G.; Evans, D. D.** Conductivity instrumentation for *in situ* measurement of soil salinity: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 787-789, illus., table, 1969.

A transducer has been developed which is capable of assessing, *in situ*, the electrical conductivity of soil water. The transducer is constructed of porous glass with platinum electrodes and operates over the entire field moisture range. The transducer is accurate to within 10 percent when measured with an associated solid state meter in a conductivity range of 1-20 millimhos/cm at 25°C and a temperature range of 5-45°C. Typically, the time required to achieve 63 percent of equilibrium response, in aqueous solutions, is less than 2 hours. — Authors' abstract

**Engel, P.** *See* Nowacki, W. 07704

**Engels, Joan C.** *See* Forbes, Robert B. 00201

07610 **Epstein, Jack B.; Hosterman, John W.** Residual clay deposits in rocks of Early and Middle Devonian age near Kunkletown, Pennsylvania, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D94-D105, illus., tables, 1969.

Residual white clay deposits and sedimentary rock saprolites occur in complexly folded cherty shale limestones and limy shales of Early and Middle Devonian age in Cherry and Chestnut Ridges between Kunkletown and Saylorsburg, Monroe County, Pa. The deposits are located southwest of the Wisconsin-age terminal moraine and are believed to have formed during pre-Wisconsin weathering. Comparison of fresh rocks and weathered counterparts shows that in the saprolites calcite and minor dolomite have been removed by leaching, 2M muscovite has altered to *Md* muscovite, and chlorite has been removed with the development of kaolinite. Since 1891, the residual white clay has been used for brick, ceramics, porcelain, electrical insulators, and paint, and is presently used in the manufacture of white cement. — Authors' abstract

07285 **Estes, Richard.** Two new Late Cretaceous fishes from Montana and Wyoming: Breviora, no. 335, 15 p., illus., 1969.

Disarticulated remains of two new fishes from the Hell Creek Formation, McCone County, Mont., are described. *Palaeolabrus montanensis*, n.sp., is referred to a genus previously recorded only from the late Paleocene or early Eocene of Belgium; Palaeolabridae, n.fam., is proposed for the genus. *Palaeolabrus* was originally described as a labrid teleost, but the new Hell Creek Formation material suggests specialized amioid holostean or, possibly, very primitive teleostean affinities. The second new fish, *Coriops amnicolus*, n.gen., n.sp., is referred to the teleost family Albulidae; Estes (1964) originally reported it from the Lance Formation, Niobrara County, Wyo., but proposed no name. — VMJ

07286 **Estes, Richard; Berberian, Paul; Meszoely, Charles A. M.** Lower vertebrates from the Late Cretaceous Hell Creek Formation, McCone County, Montana: Breviora, no. 337, 33 p., illus., tables, 1969.

The Hell Creek Formation at the Bug Creek Anthills locality has yielded 54 species of fishes, amphibians, and reptiles. The faunal list closely resembles that from the Late Cretaceous Lance Formation in eastern Wyoming (Estes, 1964). However, several species found in Montana are absent from Wyoming. Both localities are in the upper third of the Hell Creek and Lance Formation sections, respectively. A similar floodplain-riparian association occurs in both areas, including hybodontid, pristid, and dasyatid sharks; sturgeons and paddlefish; amiid, albulid, and sciaenid fishes; 6 genera of salamanders; 4 of frogs; 7 of turtles; 11 of lizards; 2 of snakes; 2 of crocodilians; 8 of dinosaurs. Slight climatic, ecological, and geographical differences are probably responsible for minor differences between the faunas. — *from* Authors' abstract

**Eugster, H. P.** *See* Williams, Richard J. 07544

**Evans, D. D.** *See* Enfield, C. G. 07732

00208 **Evernden, J. F.; Kistler, R. W.** Chronology of emplacement of Mesozoic batholithic complexes in California and western Nevada: U.S. Geol. Survey Prof. Paper 623, 42 p., illus., tables, 1970.

The Ar-40/K-40 ratio was determined for minerals from Mesozoic granitic rocks sampled at 250 localities in California and western Nevada. Analytical reproducibility of ratios in common minerals from granitic rocks was tested and results were studied for interpretation of genetic significance of K-Ar ages derived from the ratios. Ages of minerals from Mesozoic granitic rocks in California have a continuity from 210-80 m.y. ago; however, a distinct periodicity of magma generation and intrusion is shown when ages are related to distribution of genetic groups of plutons based on geologic mapping. Five epochs of magma generation and emplacement that took from 10-15 m.y. were initiated at approximately 30-m.y. intervals. Each intrusive epoch was preceded by, or was in part contemporaneous with, a period of regional deformation in California or western Nevada. — *from* Authors' abstract

**Ewart, A.** *See* Taylor, S. R. 07364

07104 **Ewing, John.** Seismic model of the Atlantic Ocean, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 220-225, illus., 1969.

The Mohorovicic discontinuity in the Atlantic occurs at an average depth of 12 km, except in the Mid-Atlantic Ridge area, where it occurs at shallower depths and is apparently absent in the crestal zone. The oceanic layer (layer 3) is about 5 km thick; layer 2 averages 1.5 km in thickness, and the sediments of layer 1 vary widely in thickness depending mainly on distance from a well-drained continental margin, bottom topography, and oceanographic conditions. Continuous reflection profiling has contributed extensively to measurement of local variations in sediment thickness, which generally were obscured by the averaging effect of the refraction method. — MS

07307 **Facca, G.** Geophysical investigations in the self-sealing geothermal fields: Bull. Volcanol., v. 33, no. 1, p. 119-121, 1969.

All geothermal fields producing commercial steam have a cap rock above the producing aquifer. When the impermeability of the cap rock is due to the hydrothermal activity itself, the field is said to be self-sealing. The Ahuachapán geothermal area in El Salvador offers strong evidence of self-sealing, and has been surveyed by geochemical, gravity, resistivity, magnetic, and gradient methods. The interpretation of the field data suggests that valuable information on the extent and location of self-sealing can be obtained by such surveys; if this is confirmed by further studies, exploration for geothermal fields can be carried out more effectively and at lower cost. — DBV

07570 **Faill, Rodger T.** Tectonic development of the Triassic basin in Pennsylvania [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 273-275, 1969.

**Fawcett, J. J.** *See* James, R. S. 07388

**Feden, Robert H.** *See* Ballard, J. Alan. 00105

**Felsher, Murray.** *See* Hickman, G. Daniel. 07139

**Fenner, Peter.** *See* Romey, William D. 07469

**Ferguson, R. B.** *See* Subbarao, K. V. 07514

00195 **Feugere, G.; Gerard, R. E.** Geochemical logging — A new exploration tool: World Oil, v. 170, no. 2, p. 37-40, illus., 1970.

This new technique evaluates well-bore cuttings and quickly qualifies or negates an exploratory venture as worthy of additional investment or abandonment. It is used in surface, early, and late stages of petroleum exploration. — GHD

07371 **Filson, John Roy.** Horizontal transverse motion from earthquakes at near distances [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2262B, 1969.

07128 **Findlay, D. C.** The mineral industry of Yukon Territory and southwestern District of Mackenzie, 1968: Canada Geol. Survey Paper 69-55, 71 p., tables, 1969.

Value of Yukon mineral production for 1968 was about 23.5 million dollars (preliminary figure), up from 1967 production of 15 million dollars. The increase reflects mainly the effects of increased asbestos and copper production. The only active mine in Nahanni District (southwest District of Mackenzie) was producing over 3 1/2 million lbs tungsten and 645,000 lbs of copper. — *from* Author's abstract

07355 **Fink, Lloyd Kenneth, Jr.** Geology of the Guadeloupe region, Lesser Antilles Island Arc [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2279B, 1969.

**Fischer, Richard P.** *See* McKnight, Edwin T. 00207

00151 **Fisher, John J.** Coastal development of Narragansett Bay as related to possible fault structures [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 17-18, 1970.

**Fite, L. E.** *See* Santos, G. G. 07742

00152 **Flessa, Karl W.** Observations on the burrows of some modern bivalves [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 18, 1970.

**Fleuty, Michael J.** *See* Tobisch, Othmar T. 07640

00193 **Flint, George M., Jr.; Pitkin, James A.** Aeroradioactivity map of the Chicago area, Illinois and Indiana: U.S. Geol. Survey Geophys. Inv. Map GP-681, scale 1:250,000, text, 1970.

Aeroradioactivity measured in the Chicago area ranges from 0 to more than 2,000 cps. Radioactivity of more than 700 cps cannot be related to natural effects (see U.S.A.E.C. Civil Effects Study CEX-59.4.13, 1969, Flint and Pitkin). Glacial deposits and loess almost completely cover the Paleozoic sedimentary bedrock which is generally of heterogeneous composition and not well defined by the aeroradioactivity data. Low counts of 50-300 cps fairly well define glacial outwash sand and lacustrine material in the eastern section; a low of 150-300 cps is associated with lacustrine material of glacial Lake Chicago around East Chicago and Gary, Ind.; 500-650 cps is approximately associated with end moraine material; locally variations of 50 cps distinguish morainal units from adjacent glacial units. — MCM

00153 **Flint, Jean-Jacques.** Topologic implications of bifurcation ratios [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 18-19, 1970.

00154 **Flint, Norman K.; Hamel, J. V.** Application of geology in highway planning and design [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 19, 1970.

00155 **Foland, K. A.; Quinn, A. W.; Giletti, B. J.** Jurassic and Cretaceous isotopic ages of the White Mountain magma series [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 19-20, 1970.

07666 **Foote, R. S.** Improvement in airborne gamma-radiation data analyses for anomalous radiation by removal of environmental and pedologic radiation changes, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 187-196, illus., discussion, 1969.

Analysis of airborne gamma-radiation spectral data from an array of NaI(Tl) detectors provides isoradiation maps of average surface concentrations of U, Th, and K, only if aircraft and atmospheric radiations are properly measured and removed. Airborne measurement of Bi-214 intensities at 400-ft altitude indicates that as much as 70 percent of the data originates in the atmosphere as a result of decay of atmospheric radon concentrations; these atmospheric intensities are being measured and removed from the data. Accumulated data indicate a specific correlation between average intensities of radiation from decay of natural radionuclides within pedologic environments. Digital data from magnetic tape multichannel analysis systems can be reduced by computer operation to give isoradiation maps that indicate regions of anomalous radiation where effects of surface pedologic changes are minimized. — *from* Author's abstract

00201 **Forbes, Robert B.; Engels, Joan C.** $K^{40}/Ar^{40}$ age relations of the Coast Range batholith and related rocks of the Juneau Ice Field area, Alaska: Geol. Soc. America Bull., v. 81, no. 2, p. 579-584, illus., table, 1970.

Whole rock and biotite K-Ar ages of the quartz monzonite composing the East Marginal Pluton of the Coast Range Batholith, range from 47 to 53 m.y. Hornblende and biotite ages of migmatitic gneisses range from 50 to 56 m.y., and of crystalline schists on Blackerby Ridge from 57 to 60 m.y. Apparent hornblende and biotite ages increase to the southwest in the crystalline schists on the south margin of the batholith.

These data suggest that metamorphism occurred in Late Cretaceous or early Tertiary time in the West Marginal Belt, and the East Marginal Plutons were emplaced during the Eocene. — *from* Authors' abstract

07198 **Forbes, Warren C.** Unit-cell parameters and optical properties of talc on the join $Mg_3Si_4O_{10}(OH)_2$-$Fe_3Si_4O_{10}(OH)_2$: Am. Mineralogist, v. 54, nos. 9-10, p. 1399-1408, illus., tables, 1969.

Values of $d(003)$, $d(060)$, and $\gamma$ were measured for talcs of varying Fe/(Fe + Mg) ratios synthesized under controlled conditions of temperature, pressure, and oxygen fugacity. The effect of iron on the $d(003)$ spacing is strongly dependent on oxygen fugacity. At higher relative oxygen fugacities, $d(060)$ may be slightly larger than that of iron-free talc, but does not vary significantly with further iron substitution. The index, $\gamma$, increases with iron content, but there is no apparent correlation between $\gamma$ and oxygen fugacity. The pronounced effect of oxygen fugacity on the cell dimensions of iron-bearing talc suggest that talc may be of some use as an indicator of oxygen fugacity in natural environments. — *from* Author's abstract

**Fowler, Don D.** *See* Powell, John Wesley. 07171

07571 **Fowler, Gerald A.; Kulm, L. D.; Duncan, John R.; Griggs, Gary B.** Late Quaternary deep-sea stratigraphy and paleoclimatology of a middle to high latitude region, northeastern Pacific [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 275-277, 1969.

07221 **Fox, R. Chris.** (compiler). Consolidated index to samples, cores, electrical and other mechanical logs filed in Utah Geological and Mineralogical Survey Library of Samples for Geologic Research — 2d supp. to Circ. 50 (1950-1966), material added in 1968: Utah Geol. and Mineralog. Survey Circ. 53, 12 p., 1969.

07131 **Frarey, M. J.; Cannon, R. T.** Notes to accompany a map of the geology of the Proterozoic rocks of Lake Panache-Collins Inlet map-areas, Ontario (41 I/3, H/14): Canada Geol. Survey Paper 68-63, 5 p., geol. map, 1969.

The map-area comprises rocks of both the Southern and Grenville Structural Provinces. The former consist of more than 30,000 feet of Huronian sedimentary rocks intruded by granite and diabase of two or more ages. The Grenville rocks constitute gneisses of supracrustal origin invaded by and mingled with granitic and dioritic intrusions. The postulate, made many years ago, that the Grenville gneiss complex in this map-area is the metamorphosed equivalent of Huronian strata is, in general, supported. [The map is no. 21-1968 of the Canada Geol. Survey Prelim. Map Ser.] — Authors' abstract

07278 **Freeze, R. A.** Hydrology of the Good Spirit Lake drainage basin, Saskatchewan — A preliminary analysis: Canada Dept. Energy, Mines and Resources Inland Waters Br. Tech. Bull. 14, 36 p., illus., tables [1969?].

The objectives of this project are to develop improved methods of estimating the ground-water component of the hydrologic balance, to investigate the mechanism of ground-water recharge and discharge, and to arrive at a preliminary water balance for the basin. Ground-water flow patterns were studied by installing piezometers in drill holes, and measuring permeability. — ESL

**Friedman, G. M.** *See* Sanders, John E. 00178

00156 **Friedman, Gerald M.; Gavish, Eliezer.** Chemical changes in interstitial waters from lagoonal, estuarine, tidal marsh, and deltaic environments [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 20-21, 1970.

**Friedman, Irving.** *See* Smith, George I. 07495

**Friedman, Irving.** *See* Winograd, Isaac J. 07548

**Friedman, Irving.** *See* Gleason, Jim D. 07628

07279 **Fritts, Crawford E.** Geology and geochemistry in the southeastern part of the Cosmos Hills, Shungnak D-2 quadrangle, Alaska: Alaska Div. Mines and Minerals Geol. Rept. 37, 35 p., illus., table, geol. map, 1969.

Four main stratigraphic formations, Paleozoic to Cretaceous, are recognized in the southeastern Cosmos Hills. The most important structure is a window 20 mi long and 5-8 mi wide bounded by two major low-angle overthrust faults. Lower and upper plates of allochthonous rocks have been thrust over autochthonous dolomitic Devonian limestone which contains chalcopyrite, bornite, and chalcocite. Overthrust faulting was preceded by emplacement of granite, doming, progressive regional metamorphism, and block faulting in Cretaceous time, and accompanied by dynamic metamorphism and followed by high-angle faulting in post-Cretaceous time. There is no evidence that copper mineralization accompanied emplacement of granite. Placer gold deposits have been most productive on streams with gradients of 150-200 feet/mi in areas underlain mainly by phyllite cut by quartz veins; jade is derived from small bodies of highly sheared serpentinite. — *from* Author's abstract

00082 **Fuller, Brent D.; Ward, Stanley H.** Linear system description of the electrical parameters of rocks: IEEE Trans. Geosci. Electronics, v. GE-8, no. 1, p. 7-18, illus., 1970.

The electrical behavior of rocks exhibits a marked frequency dependence which has been difficult to interpret on a macroscopic scale except with resort to "abnormal" behavior. An important aspect of the interpretation of measurements is in the connection of measured quantities to the defined electrical parameters. This study utilizes a linear system analogy for a material having condictivity and permittivity which vary with frequency to show: that the electrical parameters for such a material must generally be considered complex functions of frequency; that measurements yield only combinations of these parameters; and that the complex formulation predicts, in a qualitative sense, the measured results. — Authors' abstract

**Fuller, J. G. C. M.** *See* Shearman, D. J. 07363

07127 **Fulton, Robert J.** Glacial lake history, southern Interior Plateau, British Columbia: Canada Geol. Survey Paper 69-37, 14 p., illus., table, 1969.

Like most major drainage basins of the Interior Plateau of southern British Columbia, the Nicola, Thompson, Shuswap and North Okanagan basins contained glacial lakes during the ice retreat following the Fraser Glaciation climax. The Nicola was occupied by three glacial lakes, draining south, east, and north, respectively. The Thompson contained two glacial lakes which drained to the east. The North Okanagan was occupied by one main lake, glacial Lake Penticton which drained south, and one small lake. Two major glacial lakes formed in the Shuswap; both drained into the Okanagan Valley. Deglaciation of the Interior Plateau was well advanced by 9,750 B.P., and by 8,900 B.P. all ice had melted and the lakes had been drained. — *from* Author's abstract

**Fuqua, Ben.** *See* Brown, D. A. 07267

**Furuta, T.** *See* Rhodes, J. R. 07668

**Gaffney, Eugene S.** *See* Olsson, Richard K. 00172

**Galli-Oliver, Carlos.** *See* Gutentag, Edwin D. 07617

**Gamble, E. E.** *See* Steele, Forrest. 07727

00100 **Garrison, Louis E.** Development of continental shelf south of New England: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 1, p. 109-124, illus., table, 1970.

A continuous reflection study of the continental shelf south of New England shows five prominent acoustical reflecting horizons which are (1) crystalline basement, (2) the Upper Cretaceous-Tertiary boundary, (3) the Paleocene-Eocene boundary, (4) a middle Tertiary event, and (5) the Pleistocene erosional unconformity. Structural

mapping on these horizons indicates two major marine regressions after Early Cretaceous time. The first regression was characterized by the growth of deltas and an increase in the rate of basement subsidence. As a result, the continental shelf near the present Hudson Canyon was extended at least 100 km seaward, mainly during Oligocene time. The second regression was caused by the repeated eustatic withdrawal of the sea during Pleistocene glaciation. Large thicknesses of sediment were removed from the shelf, and sediments as old as Late Cretaceous were exposed. — *from* Author's abstract

**Garrison, Louis E.** *See* Walker, Jack R. 07273

**Garza, S.** *See* Hiss, W. L. 07141

**Garza, S.** *See* Peterson, J. B. 07635

**Gasparrini, E. L.** *See* Naldrett, A. J. 07694

07645 **Gast, R. G.; VanBladel, Robert; Deshpande, K. B.** Standard heats and entropies of exchange for alkali metal cations on Wyoming bentonite: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 661-664, illus., tables, 1969.

Standard heats of exchange, $\Delta H°$, for alkali metal cation exchange on Wyoming bentonite were determined directly using a Calvet microcalorimeter and indirectly from the temperature dependence of equilibrium selectivity coefficients. Standard entropies of exchange, $\Delta S°$, were calculated by combining the standard heats and free energies of exchange. While the entropy changes do contribute significantly to the free energy of exchange, they indicate only relatively small hydration changes. — Soil brief

07326 **Gavasci, Anna Teresa.** Uranium emplacement at Garnet Ridge, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2250B, 1969.

**Gavish, Eliezer.** *See* Friedman, Gerald M. 00156

**Gearhart, M.** *See* Hawkins, W. K. 07667

**Gelpi, E.** *See* Oro, J. 07711

07269 **Gendzwill, D. J.** Underground applications of seismic measurements in a Saskatchewan potash mine: Geophysics, v. 34, no. 6, p. 906-915, illus., tables, 1969.

The seismic refraction method was used underground in a Saskatchewan potash mine to monitor the thickness of the salt formation throughout the mine. The statistical random error in the interpretation, which was due primarily to noise created by the mining machines, ranged from ± 4-15 feet for typical thicknesses of about 130 feet. Seismic techniques aided in locating a nearly completed mine shaft with respect to existing underground workings. By using the relative time differences between geophones, the position of the center of the shaft was estimated to be 340 ± 2 feet northeast and 235 ± 10 feet northwest of a reference point. This compared with the actual position of 342.2 feet northeast and 228.5 feet northwest of the reference position determined upon completion of the shaft connection. — GV

**Gerard, R. E.** *See* Feugere, G. 00195

07743 **Ghiselin, Michael T.** The triumph of the Darwinian method: Berkeley and Los Angeles, Calif., Univ. California Press, 287 p., illus., 1969.

An analysis is made of Darwin's concepts in natural history and in geology as well in an effort to reconstruct the sequence of and rationale behind his thinking. It is argued here that "Darwin's evolutionary biology grew out of his geology, and that essentially all of his work in other fields of biology was the direct consequence of his insights into the nature of evolutionary processes. All of Darwin's writings constitute a unitary system of interconnected ideas and his success may be explained by his syste-

matic, imaginative, and rigorous reasoning and by his ability to criticize his own ideas. The text includes ten chapters as follows: geology, biogeography and evolution, natural selection, taxonomy, barnacles, a metaphysical satire, variation, evolutionary psychology, sexual selection, and conclusions. — VSN

**Gibbs, G. V.** *See* Ribbe, P. H. 07465

00192 **Gigl, Paul D.; Dachille, Frank.** P-T studies in the alumina-water system [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 43-44, revised 1970; originally published 1969.

**Gildersleeve, Benjamin.** *See* Shawe, Fred R. 07625

**Gile, William.** *See* Smith, Stewart W. 07358

**Giletti, B. J.** *See* Foland, K. A. 00155

**Gillieson, Archibald H.** *See* Nickel, Ernest H. 07730

00102 **Gilluly, James; Reed, John C., Jr.; Cady, Wallace M.** Sedimentary volumes and their significance: Geol. Soc. America Bull., v. 81, no. 2, p. 353-375, illus., 1970.

The total sedimentary volume of Phanerozoic rock onshore and offshore of the contiguous U. S. is estimated to be $60 \times 10^6 km^3$ (± 10 percent), and to represent an accumulation of about 10 m/m.y. Products of continental denudation compose about 95 percent of the total; volcanic rocks, 5 percent. This total volume is so large, representing, as it does, erosion of only 5.3 percent of the continental surface of the Earth during 1/6 of recognizable geologic time, that it appears to invalidate schemes of geochemical balance, and to point strongly to the hypothesis that oceanic salt is merely cyclic salt that has not yet returned to the continents in a continuing cycle. The great disparity in volumes of sediment offshore in the Atlantic ($10^6 \times 10$ km$^3$) and Pacific ($2 \times 10^6 km^3$) is consonant with a westward-moving continent that has been over-riding the Pacific Basin on a now-dormant Benioff fault system. — HCW

07212 **Given, Peter H.** The chemical aspects of coal metamorphism (a prepared contribution), *in* Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), p. 427-428, 1969.

A method of laser mass spectrometry developed for structural study of heterogeneous solids has been applied to study of coals with some results of geochemical significance. Large peaks at M/e = 50 and 74, and a smaller one at 26, are attributed to acetylene, di- and triacetylene. The ratio of intensities, 50/74 varies little with coal rank, indicating a common origin for the substances responsible, $C_4H_2$ and $C_6H_2$, believed to be fragmentation of benzene rings in mono- and poly-cyclic aromatic structures. Dihydroxy peaks, 110 and 124, prominent in spectra of lowest rank coals, decrease in intensity relative to the monohydroxy and hydrocarbon peaks at higher rank. The mass spectral data reported give first evidence of more than one OH group in one benzene ring, which could be detection of a chemical fossil of the original plant structure. — GDC

00157 **Glaeser, J. Douglas.** Correlation of Catskill sedimentary environments and its economic significance [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 21, 1970.

07628 **Gleason, Jim D.; Friedman, Irving; Hanshaw, Bruce B.** Extraction of dissolved carbonate species from natural water for carbon-isotope analysis, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D248-D250, illus., tables, 1969.

The best method for separating the dissolved carbonate species from natural water in order to determine the $\delta C^{13}$ value of carbon in the aqueous phase appears to be a direct-precipitation method. This method consists of adding ammonium hydroxide

strontium chloride solution directly to the sample of natural water to be analyzed. The strontium carbonate thus formed precipitates, and is subsequently separated, dried, and analyzed for its $\delta C^{13}$ value. The ammonium hydroxide strontium chloride solution can absorb carbon dioxide from the air; it is therefore extremely important that both the water sample and the prepared solution not be exposed to the air during handling and filtration. Exposure for a few minutes will cause contamination and give incorrect $\delta C^{13}$ values. — Authors' abstract

**Glen, G. L.** *See* Dodd, Charles G. 07188

07322 **Goldsmith, William Alee.** Radionuclide retention from dilute solutions by Panamanian soil clays [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2225B, 1969.

**Goodell, H. G.** *See* Huang, T. C. 07379

07179 **Gordon, Wesley D.** A Pleistocene ecosystem: Chicago, Ill., Rand McNally and Co. (Patterns of Life Ser.), 79 p., illus., tables, 1969.

This popular account contains sections on: facts about ecosystems, fossil-bearing sediments, finding the fossils, identifying and naming a new species, determining age and origin, Irvington biota (data and interpretation), reconstructing scenes in time past, and amateurs and fossil-finding at Irvington [Calif.]. References are grouped into: geological information and fossils, general, and ecology. — MCM

**Gorsline, Donn S.** *See* Hyne, Norman J. 07384

07572 **Gottfried, David; Rowe, J. J.; Tilling, R. I.; Dodge, F. C. W.** Geochemical behavior of gold during magmatic differentiation [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 277-278, table, 1969.

**Granquist, W. T.** *See* Wright, Alan C. 07206

07265 **Gray, D. H.; Schlocker, J.** Electrochemical alteration of clay soils [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 5, p. 309-322, illus., table, 1969.

The composition and physical properties of three clay soils were altered by introducing aluminum under an electro-chemical gradient. By X-ray diffraction and selective chemical extraction, Al was detected in treated samples in both exchangeable form and as a hydroxyl-aluminum interlayer; Al-oxide minerals such as gibbsite were not detected. Mineralization by Al ions was speeded and intensified in bentonite soils by buffering the catholyte with carbon dioxide. Plasticity of bentonite soil from South Dakota was reduced markedly, whereas illite soil from Illinois and illite-montmorillonite soil from Mississippi were relatively unaffected. Induration was most pronounced in bentonite soil with high water content and alkaline pH largely because of hydroxyl-aluminum interlayering in clay. Interlayering was negligible in illite soil with low pH; here the main effect of treatment was addition of Al in exchange sites. — *from* Authors' abstract

**Green, D. H.** *See* Ringwood, A. E. 07058

07070 **Green, D. H.; Ringwood, A. E.** The origin of basalt magmas, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 489-495, illus., table, 1969.

Recent advances in knowledge of the melting and fractionation of natural basalts at high pressures are reviewed with reference to their significance for interpretation of the derivation of basaltic magmas and melting processes in the upper mantle. The data indicate that the upper mantle is inhomogeneous in chemical composition and mineralogy and that the process of magma generation is complex and highly variable, partly as a result of variations in partial melting, the formation of local crystal accumulated by magma fractionation at depth, and selective wall-rock reaction processes. — MS

00091 **Green, W. V.; Zukas, E. G.** Stored energy in creep deformed graphite: Nature, v. 225, no. 5233, p. 628-629, illus., 1970.

Graphite which has been strained in tensile creep releases a very large amount of stored energy when the creep stress is reduced. The fact that graphite lacks slip systems capable of plastically deforming any given crystal along the c-axis must in some way be responsible for the large buildup of stored energy. — DBV

00158 **Grew, Edward S.** Stratigraphy of the Worcester area, central Massachusetts [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 21-22, 1970.

07305 **Griffin, Villard S., Jr.** Inner Piedmont tectonics in the vicinity of Walhalla, South Carolina: South Carolina Div. Geology Geol. Notes, v. 14, no. 1, p. 15-28, illus., geol. map, 1969.

The Inner Piedmont zone in the Walhalla area consists of two belts. One, bounded northwest by the Brevard zone, is composed of bands of probable metasediments of upper greenschist to low amphibolite facies, which vary considerably in width along strike but are continuous. Immediately southeast is the westernmost part of a greater belt of more typical Piedmont rocks, variably migmatized and granitized. Recumbent isoclines on all scales exemplify the structural style in both belts, with significant differences. The macroscopic fold axes within the narrow nonmigmatitic belt are essentially horizontal. Similar axes in the vast migmatitic belt plunge around 10° northeastward, with more intricate and complex folds. If the Haller (1956) model of stockwork folding may be applied, the nonmigmatitic belt would represent a narrow infold of the detachment zone, and the migmatitic belt the infrastructure. — *from* Author's abstract

**Griffiths, John C.** *See* Ondrick, Charles W. 07584

**Griggs, Gary B.** *See* Fowler, Gerald A. 07571

**Grimes, David J.** *See* Curry, Kenneth J. 07252

**Gross, David L.** *See* White, George W. 07659

**Growitz, D. J.** *See* Signor, D. C. 00077

07287 **Gubelin, E.** On the nature of mineral inclusions in gemstones [Pt. 1]: Gems and Gemology, v. 13, no. 2, p. 42-56, illus., 1969; Pt. 2, ibid., no. 3, p. 74-88, illus., 1969.

The origin of pre-existent, syngenetic, epigenetic, and subsequent inclusions is described to show the conclusions on formation of gemstones that can be drawn from knowledge of the inner paragenesis. Facets of a cut gemstone often distort the crystal form, and crystals may be contorted or of irregular shape making it difficult to identify inclusions. More scientists have been devoting themselves to painstaking research in this field, and results of these studies are described and illustrated by color plates. New research techniques are reviewed, and work by W. F. Eppler, W. E. Sharp, B. W. Anderson, and P. C. Zwaan is given in more detail. Gemologists must continue the search for techniques and tools that will solve problems without damaging or destroying the costly materials. The electron microprobe, a very promising instrument, is described and illustrated, and results of some studies given. — ESL

07357 **Gude, Arthur J., 3d; Sheppard, Richard A.** Hydrous sodium silicate minerals, Trinity County, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 86, 1969.

**Gude, Arthur J., 3d.** *See* Sheppard, Richard A. 07608

**Guertin, Joseph D.** *See* Wilkinson, Thomas A. 07543

00159 **Gupta, Alok K.** The system forsterite-diopside-akermanite-leucite and its significance in the petrogenesis of potassium-rich mafic and ultramafic volcanic rocks [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 22, 1970.

07617 **Gutentag, Edwin D.; Galli-Oliver, Carlos.** New locations of Pleistocene (Kansan) molluscan and ostracode faunas, Dickinson County, Kansas, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D148-D154, illus., tables, 1969.

Identification of the lithologic composition and faunal content of Pleistocene deposits at the Abilene and Chapman quarries indicates a Kansan age. The Pearlette Ash Member of the Sappa Formation found at the Abilene quarry is considered to be of late Kansan age. A study of the inferred habitats at the Abilene quarry shows a succession of habitats: (1) perennial stream, (2) lake or pond, (3) small pond with deposition of the ash, and (4) terrestrial. At Chapman the faunal data indicate aquatic habitats. — Authors' abstract

07176 **Haber, Heinz.** Our blue planet — The story of the Earth's evolution (translated by Ernst Stuhlinger): New York, Charles Scribner's Sons, 86 p., illus., 1969; originally published in German, 1965.

This book is based on a series of eight lectures on the evolution of the Earth, presented over Radio Munich in 1964, and later expanded into a television series. Following an introduction, the sections of the book are entitled: origin of the Earth, internal structure, expansion of the Earth, age of our planet, origin of the atmosphere and of the oceans, origin of life, development of climates, and future of the Earth. A subject index is appended. — MCM

07259 **Habrich, Wulf.** Vegetationshöcker auf steilgeneigten Terassenhängen in der Frostschuttsone Nordostkanadas [with English abs.]: Polarforschung 1968, v. 38, pt. 6, nos. 1-2, p. 212-214, illus. [1969].

The systematization of frost soil patterns undertaken by Büdel [1960] is not sufficient and has to be extended. In the high arctic regions of the Canadian Arctic Archipelago fully developed vegetation hummocks could be observed on steep terrace slopes of 30° and more. Regional factors are responsible for their formation and preservation. Especially there seems to be an interrelation between the kind of vegetation and the size of the hummocks. — Author's abstract

00127 **Hadley, James W.** [Discussion of a chart showing relation between earthquake magnitudes and energy, 1969]: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 1, p. 16-17, illus., 1970.

The writer finds the chart (ibid., v. 22, no. 5, 1969) quite misleading because it implies that an underground explosion of a given energy release will produce earthquake-like effects much stronger than is actually the case. A chart showing magnitude-yield curves for various materials is included. — ESL

07215 **Hadley, Jarvis B.** Geologic map of the Varney quadrangle, Madison County, Montana: U.S. Geol. Survey Geol. Quad. Map GQ-814, scale 1:62,500, sections, 1969.

07101 **Hagiwara, Takahiro.** Prediction of earthquakes, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 174-176, 1969.

Crustal deformation reflected by anomalous changes in tilt or strain, microseismic activity, and changes in the Earth's magnetic field are among the criteria of potential significance for earthquake prediction. Further investigation may confirm the tentative conclusions based on observations of various Japanese earthquakes and on laboratory studies of fracture mechanisms. — MS

07317 **Hall, Kenneth McCoy.** A mathematical model to describe the consolidation process in fine-grained soils [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2156B, 1969.

**Hall, Minard L.** *See* Perry, Eugene C. 07443

**Halsey, S. D.** *See* Perkins, R. D. 07442

**Hamel, J. V.** *See* Flint, Norman K. 00154

07655 **Hamilton, Wayne L.** Microparticle deposition on polar ice sheets: Ohio State Univ. Inst. Polar Studies Rept. 29, 77 p., illus., table, 1969.

It is determined that much of the variation in the kinds, concentration, and size distribution of microparticles in snow accumulation on the Greenland and Antarctic ice sheets is the result of seasonal and regional differences in temperature and precipitation rate. Observed variations in microparticle deposition over intervals of several years and several centuries may be due to climatic changes. The experimental procedure is detailed, and results described include time-stratigraphic and regional distribution, origin of the microparticle deposition pattern, stratigraphic interpretation of sample profiles, regional distribution of meltwater electrical conductance, comparison of results with independent investigations, and possible indication of climatic change. — ESL

07249 **Hanawalt, J. H.; Johnson, G. G., Jr.** Manual and computer aids for utilization of the ASTM X-ray Powder Data File [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 650, 1969.

07626 **Handy, A. H.; Mower, R. W.; Sandberg, G. W.** Changes in chemical quality of ground water in three areas in the Great Basin, Utah, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D228-D234, illus., table, 1969.

The chemical quality of ground water in three areas in the Great Basin, Utah, is known to be deteriorating. West of Kanosh in Pavant Valley, an increase in all major constituents except bicarbonate has been associated with a decline in water levels that has resulted from a high rate of pumping. In the upper artesian aquifer near Leamington, in the Sevier Desert, an increase in dissolved solids, mainly sodium and chloride, has resulted from a change in the chemical quality of the water that is recharging the aquifer. Between Beryl and Enterprise in Escalante Valley, an increase in the concentration of all major constituents also has been asociated with a decline in water levels caused by a high rate of pumping. — Author's abstract

07619 **Hanna, W. F.** Negative aeromagnetic anomalies over mineralized areas of the Boulder batholith, Montana, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D159-D167, illus., table, 1969.

Aeromagnetic and rock magnetic studies in the Boulder batholith area indicate that several negative anomalies are associated with weakly magnetized plutonic and volcanic rocks, normally polarized, in contact with more highly magnetic plutonic rocks, also normally polarized. The amplitudes and extents of the magnetic lows, as well as their locations relative to surface geology, suggest that considerable volumes of batholithic rocks and lesser quantities of overlying volcanic rocks have been intruded by felsic bodies and silica-rich veins containing, in part, metalliferous mineral deposits. The weak magnetizations of these rocks are attributed to a depletion of iron oxides by magmatic differentiation and to hydrothermal alteration of magnetic iron oxides to more highly oxidized and hydrated nonmagnetic iron oxides within the intruded rocks. — Author's abstract

00160 **Hansen, Harry J.** Transmissibility trends in the Coastal Plain aquifers of Maryland [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 23, 1970.

**Hansen, J.** *See* Lövborg, L. 07740

07168 **Hansen, L. Taylor.** The ancient Atlantic: Amherst, Wis., Amherst Press, 437 p., illus., tables, 1969.

This popular account of the Atlantic Ocean traces the story of its beginning with the creation of the continents, formation of the ocean itself, and geological events that have culminated in our present world. Archeological and ethnological histories of the development of civilizations of man around the Atlantic comprise a great part of the book. — MCM

**Hanshaw, Bruce B.** *See* Gleason, Jim D. 07628

07200 **Harlya, Y.; Dollase, W. A.; Kennedy, G. C.** An experimental investigation of the relationship of mullite to sillimanite: Am. Mineralogist, v. 54, nos. 9-10, p. 1419-1441, illus., tables, 1969.

In synthesis of solid phases in the system $Al_2O_3$-$SiO_2$, X-ray powder diffraction patterns of run products range continuously from the pattern of mullite to that of sillimanite depending on the P-T conditions. Cell edges and volume have been measured and found to grade continuously from those of mullite to those of sillimanite. Low pressure phases, with mullite-like patterns, can be made to change continuously in cell dimensions to those of sillimanite by increase of pressure at temperatures high enough to produce suitable reaction rates. These cell parameter changes are consistent with two different interpretations. One would attribute cell changes to a variable degree of Si-Al tetrahedral ordering between sillimanite, ordered, and mullite, disordered. The second interpretation, which seems to better fit our observations, is that of a continuous isomorphous solid solution relationship. — *from* Authors' abstract

07751 **Harksen, J. C.; Macdonald, J. R.** Type sections for the Chadron and Brule Formations of the White River Oligocene in the Big Badlands, South Dakota: South Dakota Geol. Survey Rept. Inv. 99, 23 p., illus., table, 1969.

When these formations were given geographic names by Darton in 1899, he did not designate type sections for them, but did refer to typical beds in the White River badlands. Various type areas have been designated, but only Osborn observed Darton's published intent. To dispel the confusion, the authors have formally reconfirmed the type area of the Chadron and designated a logical type section for the Brule in the badlands. Lists of vertebrate taxa from the White River Group are given, divided according to age. — ESL

07677 **Harris, Stuart A.** The meaning of till fabrics: Canadian Geographer, v. 13, no. 4, p. 317-337, illus., tables, 1969.

Pebble orientation is often mentioned as one of the diagnostic properties of tills. As the author collected data on fabrics of till sheets near Waterloo, Ontario, he became more doubtful about the methods used and conclusions reached in such studies, but they seem worthwhile provided adequate care is taken in interpretation. Techniques used in the pebble-orientation studies are described and results shown on rose diagrams. Statistical representation is discussed. Results of analyses are described under natural variability and deformation fabrics; based on these, the relation of fabric to ice movement is interpreted. Considerable care is needed in interpretation but till fabrics can be mapped to a constant degree of accuracy by the chi-square method, which determines the minimum significant orientation strength for each sample. Plotting fabrics for a given till produces consistent patterns which vary locally from one till to the next, but reflect directions of ice flow. — ESL

07303 **Harrison, Samuel S.; Clayton, Lee.** A note on the recognition, cause, and possible geologic importance of groundwater microflow systems in alluvial-channel bedforms: North Dakota Acad. Sci. Proc. 1968, v. 22, p. 93-96, illus., 1969.

Ground-water microflow systems in ripple bedforms were noted during experiments on sediment transport. Dye movement showed that ground water enters the upstream side of bedforms, flows in a concave upward arc, and emerges at the crest. Microflow is caused by pressure variations due to variations in stream velocity over the bedforms. Experiments show that induced upward moving seepage reduces the angle of repose on the lee face of bedforms, and so reduces bed roughness and form-drag flow resistance. Turbid water seeping into bedforms may introduce silt and clay into sand at the upstream face, and flush out fine sediment from the downstream face. The microflow system should be more intense in dunes than in ripples. — ESL

07327 **Harsh, John Franklin.** Relationships between streamflow and ground water in Humboldt River valley near Winnemucca, Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2250B, 1969.

07755 **Hart, Pembroke J.** (editor). The Earth's crust and upper mantle — Structure, dynamic processes, and their relation to deep-seated geological phenomena: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), 735 p., illus., tables, 1969.

This monographic compilation of papers (69 cited separately), prepared under the auspices of the International Upper Mantle Committee, represents a broad review of the results of solid earth studies during the period of the Upper Mantle Project. Particular emphasis is placed on the interrelationships of geophysical, geochemical, and geologic data and their significance for future studies of the Earth's interior. — MS

07090 **Hart, Stanley R.** Isotope geochemistry of crust-mantle processes, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 58-62, illus., 1969.

Absolute age data combined with radiogenic daughter product abundances can serve as indexes of interactions between the Earth's crust and mantle and thus provide criteria for distinguishing between such alternatives as continual continental growth or formation of crust by regeneration of old crust by fusion. Four models of possible trends of mantle evolution based on strontium isotope ratios are outlined. — MS

**Harvey, Richard D.** *See* Baxter, James W. 07282

07611 **Harwood, David S.** The Second Lake anticline — A major structure on the northwest limb of the Boundary Mountain anticlinorium, northern New Hampshire, west-central Maine, and adjacent Quebec, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D106-D115, illus., 1969.

A narrow belt of greenstone, graywacke, and slate in northern New Hampshire, west-central Maine, and adjacent Quebec, previously thought to be Devonian, is correlated with the Dixville Formation (Middle Ordovician) and is inferred to lie in the core of an anticline, the Second Lake anticline, on the northwest limb of the Boundary Mountain anticlinorium. The name Deer Brook syncline is proposed for the belt of Silurian and Devonian rocks that separates, in part, the rocks in the Second Lake anticline from the pre-Silurian rocks in the Boundary Mountain anticlinorium. — Author's abstract

00161 **Hatch, Norman L.; Stanley, Rolfe S.** Stratigraphic continuity and facies changes in formations of early Paleozoic age in western Massachusetts and tentative correlations with Connecticut [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 23-24, 1970.

00118 **Hatfield, Craig B.** Teaching versus research — The perennial criticism: Jour. Geol. Education, v. 18, no. 1 p. 44-45, 1970.

The precept that research by university faculty is deleterious to their teaching endeavors has been popular for too long. The author, a geology professor, does not believe we can produce geologists capable of participating in the progress provided through research unless we include research as a fundamental part of training. He believes that good teaching and good research are inseparable and mutually dependent. Being allowed to share in the professors' research work was the author's most professionally beneficial experience as a graduate student. The greatest damage the profession can suffer as a result of perpetuation of this erroneous concept of teaching-research incompatibility is acceptance of the idea by the public. — ESL

**Haug, Patricia A.** *See* Burlingame, A. L. 07209

**Havenaar, I.** *See* Schenck, P. A. 07207

07667 **Hawkins, W. K.; Gearhart, M.** Gamma-ray logging in uranium prospecting, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 213-222, illus., table, 1969.

Gamma-ray systems that have a wide range response are required for uranium exploration; low-grade ore bodies of marginal economic feasibility are particularly dependent on reliable, calibrated gamma-ray logs. Wide range gamma-ray counting systems for this purpose are described, with particular emphasis on the downhole wide range gamma-gross count probe; gamma-detector types, calibration of the system, and interpretation methods are reviewed; 'hardware' characteristics are detailed. It is necessary to discriminate between the valuable uranium ore and other radioactive materials of little value; therefore gamma-spectral logs are of considerable interest but available equipment limits use of such techniques. Equipment limitations and possible improvements, such as use of coaxial logging cables, are covered. — *from* Authors' abstract

07185 **Hawley, J.; Pytkowicz, R. M.** Solubility of calcium carbonate in seawater at high pressures and 2°C: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1557-1561, illus., tables, 1969.

The solubility product of calcium carbonate in seawater at high pressure was determined at 2°C. Results were used to study the degree of calcium carbonate saturation in the Pacific Ocean, and to determine the change in molal volume upon solution of calcium carbonate. — Authors' abstract

00114 **Hayashi, Taizo.** Formation of dunes and antidunes in open channels: Am. Soc. Civil Engineers Proc., v. 96, paper 7056, Jour. Hydraulics Div., no. HY 2, p. 357-366, illus., 1970.

The formation of dunes and antidunes on the erodible bed of an open channel is studied analytically as a problem of stability of the erodible bed. The phase lag existing between the local sediment-transport rate and the local velocity on the bed plays an essential role in the formation of the sand waves. A physical model for the transport of sediment over a wavy bed is presented and a quantitative explanation of this phase lag is developed. The regions of occurrence of dunes, flat beds, and antidunes are examined in detail. Predicted regions of occurrence of those bed configurations are compared with experimental results previously summarized by Kennedy (1969), the comparison showing a good agreement. — Author's abstract

00162 **Hayes, Miles O.; Boothroyd, Jon C.** Storms as modifying agents in the coastal environment [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 24, 1970.

00135 **Hayes, Philip T.** Mesozoic stratigraphy of the Mule and Huachuca Mountains, Arizona: U.S. Geol. Survey Prof. Paper 658-A, p. A1-A28, illus., 1970.

Triassic and Jurassic strata in the area, largely volcanic, are confined to the Huachuca Mountains. They rest on a surface of considerable relief and range in thickness from 0 to several thousand feet. Lower Cretaceous strata are included in the Bisbee Group. The Glance Conglomerate, at the base, rests on a surface of major relief, ranges in thickness from 0 to at least 3,600 feet, and includes a volcanic member in the Huachucas. The Morita Formation, made up mostly of continental clastic rocks, is 2,600-4,200 feet thick. The Mural Limestone, a marine unit, is 300-800 feet thick. The Cintura Formation, lithologically similar to the Morita, is locally more than 2,000 feet thick. Upper Cretaceous strata, as much as 2,000 feet thick, are confined to the Huachuca area and are included in the Fort Crittenden Formation of continental origin. — PTH

07618 **Hazel, Joseph E.** *Cythereis eaglefordensis* Alexander, 1929 — A guide fossil for deposits of latest Cenomanian age in the Western Interior and Gulf Coast regions of the United States, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D155-D158, illus., 1969.

The ostracode *Cythereis eaglefordensis* Alexander, 1929, has been found in the middle part of the Britton Formation of Moreman, Texas; lower part of Tropic Shale, Utah; upper part of Graneros Shale, New Mexico; Greenhorn Limestone, South Dakota, and in lower part of the subsurface Atkinson Formation of the Georgia-Florida area. Its Texas and Western Interior occurrences are consistent with range

zones of the ammonites *Sciponoceras gracile* and *Metoicoceras whitei*. The species appears to be a useful biostratigraphic indicator for deposits of middle Eagle Ford age (latest Cenomanian). Its occurrence in the lower part of the Atkinson, where ammonites are absent, indicates a middle Eagle Ford (middle Britton Formation) age for at least part of the lower Atkinson (the "Barlow fauna"), rather than a Woodbine age as previously suggested. — *from* Author's abstract

00081 **Healy, Henry G.** Water levels in artesian and nonartesian aquifers of Florida, 1965-66: Florida Bur. Geology Inf. Circ. 61, 55 p., illus., tables, 1970.

This report, summarizing trends and fluctuations of ground-water levels in the principal aquifers in Florida during 1965-66, includes: hydrographs of ground-water levels in the several aquifers, maps showing changes in ground-water levels during specific periods, and a table summarizing principal data on selected observation wells. Principal aquifers are: Floridan, central and northern sections; Biscayne, southeastern; and sand-and-gravel, extreme northwestern. For purposes of this report, the state is divided into four sections: northwestern, northern and north-central, central, and southern. — MCM

07103 **Healy, John H.; Warren, David H.** Explosion seismic studies in North America, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 208-220, illus., 1969.

Areas of anomalous crustal structure in widely separated regions of North America are discussed with reference to the normal crustal structure of the western province, characterized by high heat flow, volcanism, and Cenozoic tectonic activity, and the normal crustal structure of the eastern province, characterized by average to less than average heat flow and tectonic stability. The nature of a recently discovered layer within the mantle at a depth of about 100 km and its relation to the low-velocity zone in the upper mantle may prove to be a major factor in the tectonic mechanism responsible for regional vertical uplift and depression. Local density variations in the upper mantle are postulated to account for the gravity field in areas of transition between geologic provinces and areas of rapidly changing crustal structure. — MS

**Heath, Ralph C.** *See* MacNish, Robert D. 07242

00199 **Hedberg, Hollis D.** Continental margins from viewpoint of the petroleum geologist: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 1, p. 3-43, illus., 1970.

The broad zone of contact between continental and oceanic domains has been called the continental margin. Important elements of the continental margin are the outer shelf, the borderland, the marginal plateau, the slope, the base of the slope, the rise, and the marginal trench. Of particular interest to the petroleum geologist are the sediment-rich, semi-enclosed basins or seas associated worldwide with the continental margin; the structural barriers and reefs commonly developed near the rim of the continental slope; the numerous manifestations of gravity tectonics and diapirism on the slope; and the growing evidence for impressive vertical movements associated with continental margins. Through the ages the continental margin has been the great mixing bowl in which has been brewed most of the world's petroleum and from which most of its petroleum has been derived. — *from* Author's abstract

**Heimlich, R. A.** *See* Uthe, R. E. 07527

07085 **Heirtzler, J. R.** Geomagnetic studies in the Atlantic Ocean, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 430-436, illus., 1969.

Total magnetic field intensities have been contoured for many areas of the Atlantic. Anomalies of deep ocean areas have been identified with specific reversals of the Earth's magnetic field; a different cause is apparently responsible for those associated with continental margins, island arcs, and adjoining seas. Paleomagnetic field directions in both the north and south Atlantic constitute evidence supporting the continental drift theory. — MS

07360 **Helgeson, Harold C.** A chemical and thermodynamic model of sulfide deposition in hydrothermal systems [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 98-99, 1969.

07156 **Helley, E. J.** Field measurement of the initiation of large bed particle motion in Blue Creek near Klamath, California: U.S. Geol. Survey Prof. Paper 562-G, p. G1-G19, illus., tables, 1969.

More than two-thirds of the field measurements of bed velocity necessary to initiate motion of coarse natural particles whose size, shape, specific gravity, and orientation angle were known agree within 20 percent of those velocities predicted from theory which is based on balancing turning moments of fluid forces of drag and lift with resisting moment of submerged particle weight. Initial motion seems to depend more on size and shape than on specific gravity or orientation angle; shape differences almost completely compensate for differences in specific gravity ranging from 2.65-3.00 and orientation angles from 0°-25°. Bed velocities necessary to initiate motion of coarse bed material in Blue Creek are equaled or exceeded about 5 percent of the time; this fact and changes in channel topography and cross-sectional area emphasize ability of perennial mountain streams to transport coarse bed material frequently. — *from* Author's abstract

07311 **Herber, Lawrence J.** Separation of feldspar from quartz by flotation: Am. Mineralogist, v. 54, nos. 7-8, p. 1212-1215, table, 1969.

Laboratory application of flotation to the separation of oligoclase feldspar from quartz yields good results. Quartz in excess of 3 percent remained in only two of the seventeen samples studied. — Author's abstract

07106 **Herrin, Eugene.** Regional variations of P-wave velocity in the upper mantle beneath North America, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 242-246, illus., 1969.

Rather than lateral homogeneity, energy transmission through the upper mantle exhibits marked inequalities, including significantly lower velocities in the mountainous western states than in the north-central and northeastern states. These correlate broadly with regional surface geology and topography. The velocity contrasts in the western states may be a function of increased upper mantle temperatures, as heat-flow data and lower velocity and density values would imply, but lateral compositional variation may also be a factor. — MS

00215 **Herz, Norman; Valentine, L. D.; Iberall, E. R.** Rutile and ilmenite placer deposits, Roseland district, Nelson and Amherst Counties, Virginia: U.S. Geol. Survey Bull. 1312-F, p. F1-F19, illus., tables, 1970.

The Roseland district, Nelson-Amherst Counties, Virginia, long a producer of titanium minerals from lode and saprolite deposits, may also have extensive undeveloped placer deposits. Panned concentrates from the Tye and Piney River drainage areas were analyzed with these results: rutile — concentrated in the +40 mesh fraction averages 11.4 and 8.8 percent respectively in the Tye and Piney drainages; ilmenite — low is 53.7 percent in the +200 mesh of Tye, high is 76.5 percent in the +100 of Piney; zircon — concentrated in the +200 mesh; and magnetite — present and low in all samples. — *from* Authors' abstract

07122 **Hester, Norman C.; Anderson, Richard C.** Sand and gravel resources of Macon County, Illinois: Illinois Geol. Survey Circ. 446, 16 p., illus., tables, 1969.

The sand and gravel deposits of Macon County are described and mapped on a scale of 1:62,500. The most extensive deposits are located in the low terraces and floodplain of the Sangamon River, but an abundant supply of sand and fine gravel of Wisconsinan age is available in terraces of many of the streams tributary to the Sangamon, in re-entrants on the Shelbyville Moraine, and to a lesser extent, in its outwash apron. Kames and elongate ridges of sand and gravel of Illinoian age are prominent features in the southwestern portion of the county. — Authors' abstract

00206 **Heyman, Louis.** Evidence for Chazyan volcanism from the Lower Middle Ordovician Blackford Formation of Russell County, Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 24-25, 1970.

**Heyman, Louis.** *See* Kelley, Dana R. 07650

07138 **Hickey, Leo J.** Stratigraphy of the Golden Valley Formation of western North Dakota [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 100, 1969.

07139 **Hickman, G. Daniel; Felsher, Murray; Hogg, John E.; Spadaro, Anthony R.** Geological applications in the nearshore environment of the airborne pulsed neon laser [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 100-101, 1969.

**Higgins, G. T.** *See* Brett, Robin. 07365

07605 **Higgins, Michael W.** Airfall ash and pumice lapilli deposits from Central Pumice Cone, Newberry Caldera, Oregon, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D26-D32, 1969.

Of the two airfall ash and pumice lapilli deposits from Central Pumice Cone, Newberry Caldera, Oreg., the older deposit is poorly exposed and its extent unclear. The younger deposit is more distinctive, widespread, and valuable for relative dating. It can be divided into a main pumice fall, chiefly ungraded pumice lapilli that extends 20-40 miles from the caldera; and an overlying unit of as many as five graded ash falls, pumice and lithic fragments, confined to within about 3 miles of the caldera. Wood beneath the main pumice fall has a C-14 age of 1,720 ± 250 yr. China Hat and East Butte, east of the volcano and once thought to be cones, are actually domes of deposits from Newberry Volcano. What Wilcox considered pumice from a China Hat vent is part of the younger deposit's main pumice fall. — *from* Author's abstract

**Himmelberg, Glen R.** *See* Loney, Robert A. 07419

07629 **Hinkle, Margaret E.; Learned, Robert E.** Determination of mercury in natural waters by collection on silver screens, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D251-D254, tables, 1969.

A method for determining nanogram quantities of mercury in natural waters is described wherein mercury is collected on silver screens immersed in samples acidified with hydrochloric acid and the collected mercury is measured by heating the screens in a mercury-vapor absorption detector. As little as 10 nanograms of Hg in 100 ml of water can be detected by this procedure. The speed and simplicity of this method permit its use in hydrogeochemical surveys where mercury is utilized as a pathfinder element. — Authors' abstract

**Hinkley, Kenneth C.** *See* McComas, Murray R. 07277

07141 **Hiss, W. L.; Garza, S.; Peterson, J. B.** Methods used in studying the ground-water hydrology of the Permian Capitan Limestone, southeastern New Mexico and western Texas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 101-102, 1969.

**Hiss, W. L.** *See* Peterson, J. B. 07635

07142 **Hitchon, Brian.** Origin and flow of formation waters in western Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 102, 1969.

07143 **Ho, Clara L.** Chemical and mineralogical study of environmental diagenetic processes — South Pass, Mississippi River [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 102-103, 1969.

**Hodder, David T.** *See* Steller, David D. 07506

00196 **Hodge, Paul W.; Wright, Frances W.** Meteoritic spherules in ths soil surrounding terrestrial impact craters: Nature, v. 225, no. 5234, p. 717-718, illus., table, 1970.

At three meteoric crater areas — Henbury, Australia, Sikhote-Alin, U.S.S.R.; and Canyon Diablo, Arizona — spherules containing iron and nickel from the meteorite exist in the soil. At two of the sites the spherules are mostly metallic and iron oxide, while at the other (Henbury) they show a mixture of meteoritic nickel and iron and minerals from the soil. The reason for this difference is not known. Similar studies at other terrestrial meteor craters might prove useful in studying particles of similar origin on the Moon. — DBV

07762 **Hodgson, Gordon W.; Lennon, Kenneth D.; Holmes, Margot A.** Porphyrins in lava samples from the 1969 eruption of the Alae Crater of Kilauea Volcano, Hawaii [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 103, 1969.

07133 **Hoffman, James I.; Ehrlich, Robert.** Relative importance of organic complexification in natural environments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 103-104, 1969.

**Hogg, John E.** *See* Hickman, G. Daniel. 07139

**Holland, Heinrich D.** *See* Ohmoto, Hiroshi. 07705

**Hollister, L. S.** *See* Dollase, W. A. 07567

07134 **Hollister, Lincoln S.** Overstepped metamorphic reactions, Kwoiek area, British Columbia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 104, 1969.

07135 **Holloway, John R.; Burnham, C. Wayne.** Phase relations and compositions in basalt-$H_2O$-$CO_2$ under the Ni-NiO buffer at high temperatures and pressures [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 104-105, 1969.

07136 **Holmes, Charles W.** Trace elements in sediments — Indicators of depositional environments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 105, 1969.

**Holmes, Margot A.** *See* Hodgson, Gordon W. 07762

07137 **Holmes, Robert F.** Development of geologic mapping with side-looking radar (SLR) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 105-106, 1969.

07372 **Holser, William T.** Bromide geochemistry of some non-marine evaporites of the western interior United States [abs.]: Gol. Soc. America Abs. with Programs 1969, pt. 7, p. 106, 1969.

07373 **Holt, Richard J.; Murphy, Vincent J.** The in situ measurement of compressional and shear wave velocities for use in foundation design [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 106-107, 1969.

07270 **Hood, Peter J.; Kellogg, William C.** Mining geophysical activity in 1968: Geophysics, v. 34, no. 6, p. 848-858, illus., tables, 1969.

Worldwide utilization of mining geophysical methods reached a new high in 1968 with total expenditures of 41,367,011 dollars. This was divided as follows: ground methods — 20,398,288 dollars; airborne methods — 14,937,733 dollars; and research — 6,039,990 dollars. For ground methods, most money was spent on IP techniques, geochemical methods being second. Expenditures on mining research were up 48 percent from 1967, the U.S. increase being 54 percent. The leading research activity was the magnetic method, with electromagnetic research second. Airborne radiometric line-mileage showed a nine-fold increase from 1967 to 1968. — GV

**Hooker, Verne E.** *See* Becker, Robert M. 07166

07612 **Hope, Roger A.** The Blue Cut fault, southeastern California, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D116-D121, illus., 1969.

The Blue Cut fault is one of several east-west faults in a region south of the Mojave Desert and east of the San Andreas fault. Between 3 and 4 miles of left-lateral strike slip accumulated along the Blue Cut fault sometime between the Jurassic and the Quaternary. At its western end, displacements along the fault were probably translated to the Dillon fault which strikes northwest, dips northeast, and has had at least minor reverse-slip movement. At the eastern end, the Blue Cut fault may be displaced more than 11 miles right laterally by the northwest-trending Sheep Hole fault. — Author's abstract

**Hopkins, D. M.** *See* Silberman, M. L. 07491

**Hopkins, David M.** *See* Nelson, C. Hans. 07697

07374 **Hoppin, Richard A.; Jennings, Ted V.** Intersecting Laramide structural trends, Bighorn Mountain region, Wyoming-Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 107, 1969.

07094 **Horai, Ki-iti; Uyeda, Seiya.** Terrestrial heat flow in volcanic areas, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 95-109, illus., tables, 1969.

In addition to heat flow due to conduction, fluxes due to mass transport are also important although at the Earth's surface their values are usually small. Comparison of values obtained in volcanic areas of Japan, various geothermal areas, and oceanic areas leads to the conclusion that anomalously high heat flow is related to magmatic activity. Penetrative convection of mantle material is considered the most likely mechanism of nonconductive heat transfer. — MS

07375 **Horne, Gregory S.** Complex volcanic-sedimentary patterns in the Magog belt of Newfoundland [abs.]: Geol. Soc. America Abs. with Programs 1969, pt 7, p. 107-108, 1969.

07328 **Horne, Gregory Stuart.** Stratigraphy and structural geology of southwestern New World Island area, Newfoundland [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2250B-2251B, 1969.

07174 **Horne, R. A.** Marine chemistry — The structure of water and the chemistry of the hydrosphere: New York and London, Wiley-Interscience, 568 p., illus., tables, 1969.

Purposes of this book are: aid to the marine scientist, reference handbook on seawater properties, advance text for graduate students, and development of scientific chemical oceanography. Following an introduction the book is divided into four parts: (1) physical chemistry of water and aqueous electrolytic solutions (structure of liquid water, thermodynamics of seawater, transport processes in solution); (2) chemical composition of seawater (instruments and techniques, elemental composition of seas and salinity variations, chemical equilibria in the seas, dissolved gases and carbonate system, suspended particulate matter in seawater, biochemistry of oceans, radiochemistry of the seas); (3) chemistry of marine interfaces (air-sea, sea-ocean bottoms); (4) selected topics in chemical oceanography. References are given at the end of each part; tables and author and subject index are appended. — MCM

07376 **Horowitz, Daniel H.** Diagenetic reduction and alteration of the Upper Ordovician Oswego Formation in the central Appalachian Mountains [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 108, 1969.

07656 **Horst, William E; Bhappu, Roshan B.** Evaluation of ground mica products from New Mexico pegmatites: New Mexico Bur. Mines and Mineral Resources Circ. 105, 27 p., illus., tables, 1969.

To demonstrate that ground-mica products of commercial quality could be produced from potential raw material sources in New Mexico, samples from several local sources of mica in San Miguel and Rio Arriba Counties and one sample of sericite from Valencia County were processed and evaluated. Results showed that the mica and sericite appear to be satisfactory for manufacturing commercial grades of

ground-mica products. Other mica-bearing deposits in the state would require evaluation to determine the most outstanding local sources based on quality and economic value of the potential ore deposit. — *from* Author's abstract

00163 **Hoskins, Donald M.** Alternative interpretation of the Catskill-Pocono contact in the anthracite area of Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 25, 1970.

**Hosterman, John W.** *See* Epstein, Jack B. 07610

**Hosterman, John W.** *See* Roen, John B. 07735

07676 **Hotton, Nicholas, 3d.** Vertebrate fossil collections, a fragmentary document, *in* Natural history collections, past, present, future — Symposium, 1968: Biol. Soc. Washington Proc., v. 82, [art.] 48, p. 579-584, 1969.

Collection and interpretation of terrestrial vertebrate fossils are discussed with emphasis on the differences between the Cenozoic and pre-Cenozoic fossil records. Relative completeness of the Cenozoic record and similarity of the animals to living forms favors study of paleoecology (including species populations), geographic distribution, and detailed taxonomy at low levels. Much of the Paleozoic and Mesozoic fossil records have been destroyed by succeeding tectonic cycles, and most of the vertebrates are comparable only by analogy to living forms and must be studied by methods of comparative anatomy. Their study is "broad-brush" paleontology, with taxonomy significant only above the level of genus, but it provides an overall view of vertebrate evolution. The effectiveness of vertebrate paleontology requires that as much fossil and relevant living material as possible be available in collections. — VMJ

07614 **Hotz, Preston E.** Relationships between the Dothan and Rogue Formations, southwestern Oregon, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D131-D137, illus., 1969.

In southwestern Oregon, sedimentary rocks of the Dothan Formation structurally underlie metavolcanic rocks of the Rogue Formation, which in turn underlie the Late Jurassic Galice Formation. Most authors have considered this an unbroken Late Jurassic sequence; recent mapping has shown the contact between the Dothan and Rogue Formations is an eastward-dipping fault with no stratigraphic continuity between the two. Graywacke of the Dothan is metamorphosed to contorted semischist in a narrow zone adjacent to the fault. Late Jurassic granitic rocks that intrude the Rogue do not intrude the Dothan and are terminated by the fault. The fault is believed to be the northward extension from California of a fault of regional extent along which pre-Nevadan rocks of the Klamath Mts. province are thrust over post-Nevadan rocks of the Northern Coast Ranges. — *from* Author's abstract

00106 **Howard, Arthur D.; Mercado, Jose.** Low sun-angle vertical photography versus thermal infrared scanning imagery: Geol. Soc. America Bull., v. 81, no. 2, p. 521-523, illus., 1970.

For general geologic use low sun-angle photography provides sharper contrast and higher resolution than infrared imagery, at lower cost.

07377 **Howard, James F.; Webb, Douglas.** Preliminary investigations on Anegada Island, an emergent segment of the Virgin Bank [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 108-109, 1969.

07378 **Hoyt, John H.** Origin of capes and shoals along the southeastern United States coast [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 109, 1969.

07379 **Huang, T. C.; Goodell, H. G.** The sediments and sedimentary processes of the eastern Mississippi cone, Gulf of Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 110, 1969.

07380 **Huang, W. H.; Keller, W. D.** Experimental studies of kinetics and mechanisms of simulated organo–chemical weathering of silicate minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 110-111, 1969.

07381 **Hubbert, M. King.** Linguistic confusion in ground-water hydrology — A way out [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 111, 1969.

07723 **Huber, N. King.** Pink copper-bearing prehnite from Isle Royale National Park, Michigan, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D63-D68, illus., tables, 1969.

Pink prehnite, occurring as amygdules in Keweenawan lava flows in Isle Royale National Park and elsewhere in the Lake Superior region, has commonly been misidentified as thomsonite, which it superficially resembles. The pink color of the prehnite is due to internal reflections from finely disseminated native copper inclusions. — Author's abstract

07382 **Huffman, Michael E.; Scott, Ralph G.; Lorens, Phillip J.** Geologic investigation of landslides along the Middle Fork Eel River, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 111-112, 1969.

00198 **Hughes, Charles J.** The Heart Mountain detachment fault — A volcanic phenomenon,: Jour. Geology, v. 78, no. 1, p. 107-115, 1970.

Gravity tectonics alone do not account satisfactorily for the low-angle Heart Mountain detachment fault that is associated in space and time with the inception of volcanism in the Absaroka volcanic field. It is here envisaged that voluminous volcanic gas was intruded laterally at a favored stratigraphic horizon below extremely massive limestone, effectively reducing friction so that an extensive but thin sheet of this limestone and overlying rocks were able to slide along a very gentle slope ["hovercraft tectonics"]. Where the sheet cracked, gas and fluidized material escaped, and blocks of the hovering and sliding sheet abruptly came to rest. This hypothesis meets certain physical requirements imposed by depth of vesiculation and explains various puzzling major and minor structural features. — *from* Author's abstract

00205 **Hughes, Charles J.** Role of cohesive strength in the mechanics of overthrust faulting and landsliding — Discussion [of paper by K. J. Hsu, 1969]: Geol. Soc. America Bull., v. 81, no. 2, p. 607-608, 1970.

Review of the literature and a brief field excursion suggest that the Heart Mountain detachment fault, of northwestern Wyoming, is unique and was formed by a rare catastrophic event that demands a novel explanation. It is suggested that volcanic gas may have penetrated along a bedding plane and neutralized friction so that the rocks above the plane were free to glide on a very flat slope. The role of the postulated volcanic gas would have been similar to that of the cushion of air that is believed to have been trapped beneath some rapidly moving landslides as recently discussed by K. J. Hsu (ibid., v. 80, p. 927-952, 1969). Landslides are initiated on steep slopes, however, whereas the Heart Mountain fault apparently was not. — WHN

07383 **Hurley, Patrick M.** Some observations on the geological history of Laurasia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 112, 1969.

07384 **Hyne, Norman J.; Gorsline, Donn S.** Sedimentology and Pleistocene history of Lake Tahoe, California-Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 112-113, 1969.

**Iberall, E. R.** *See* Herz, Norman. 00215

07385 **Imbrie, John; Kipp, Nilva.** Quantitative interpretations of Late Pleistocene climate based on planktonic foraminiferal assemblages in Atlantic cores [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 113, 1969.

**Imlay, R. W.** *See* Jones, D. L. 07760

07148 **Indiana Academy of Science.** Neal R. Merritt (1899-1968): Indiana Acad. Sci. Proc. 1968, v. 78, p. 39-40, portrait, 1969.

**Ingham, J. Keith.** *See* Ross, Reuben James, Jr. 00210

07202 **Ismail, F. T.** Role of ferrous iron oxidation in the alteration of biotite and its effect on the type of clay minerals formed in soils of arid and humid regions: Am. Mineralogist, v. 54, nos. 9-10, p. 1460-1466, tables, 1969.

Artificial weathering of biotites in the laboratory indicates that ferrous iron is oxidized to the same extent under acid, neutral and alkaline conditions, contrary to theoretical assumptions. Under neutral and alkaline conditions, the ferrous iron oxidation causes a large decrease in surface charge and the expanded crystal lattices of montmorillonite are formed. Under acid conditions the oxidation of ferrous iron is balanced mainly by a decrease in total octahedral layer charge through loss of octahedral iron and magnesium. Accordingly, the total surface charge remains high and vermiculites are formed. This experimental work explains the field occurrence of different clay minerals formed from granitic rocks under differing climatic conditions and emphasizes the importance of the pH of the weathering environment in biotite alteration. — Author's abstract

07386 **Ito, Keisuke; Kennedy, George C.** The fine structure of the basalt-eclogite transition [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 113, 1969.

**Jackson, M. L.** *See* Roth, C. B. 07263

07632 **Jahns, Richard H.** Geologic hazards [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 114, 1969.

07387 **James, Allan H.** Hypothetical diagrams of several porphyry copper deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 114, 1969; Econ. Geology, v. 64, no. 7, p. 833, 1969.

**James, Keith H.** *See* Sadlick, Walter. 07477

07388 **James, R. S.; Fawcett, J. J.** The stability and phase relationships of the iron chlorite, daphnite ($5FeO.Al_2O_3.3SiO_2.2H_2O$) to 8.5 Kb $P_{water}$ [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 114-115, 1969.

07749 **Jamieson, John C.; Olinger, Bart.** Pressure-temperature studies of anatase, brookite, rutile, and $TiO_2$(II) — A discussion [of paper by F. Dachille, P. Y. Simons and R. Roy, 1968]: Am. Mineralogist, v. 54, nos. 9-10, p. 1477-1481, illus., 1969.

Recently published thermochemical data show that anatase is everywhere metastable with respect to rutile and the alpha-lead dioxide form of titanium dioxide in the pressure-temperature region studied by Dachille *et al.* (ibid., v. 53, p. 1929-1939, 1968). The same probably could be stated for brookite. This indicates that the reaction boundaries of Dachille *et al.* (1968) are not the approximations to equilibrium phase boundaries that they reported. — Authors' abstract

07389 **Janda, Richard J.** Significance of chemical denudation and chemical weathering in the erosion of crystalline silicate rocks in temperate regions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 115, 1969.

**Jantzen, Ronald E.** *See* McIntyre, Andrew. 07435

07653 **Jenkins, Farish A., Jr.** Occlusion in *Docodon* (Mammalia, Docodonta): Postilla, no. 139, 24 p., illus., tables 1969.

The pattern of molar occlusion in the Late Jurassic mammal genus *Docodon* [Morrison Formation, Colorado-Wyoming] was determined by "mapping" the wear facets on all known upper and power dentitions. The coincidence of lower and upper molar wear is evidence that the proposed occlusal pattern is correct. The lingual halves of the upper molars occlude in the lower intermolar basins formed by the adjacent

halves of lower molars. The buccal halves of upper molars pass buccally to the lower molar row. The disposition of opposing cusps and crests, and the verticality of most wear facets, reveal that molar function was primarily shearing rather than crushing. The vertical crenelations (or ribs and furrows) on the molar crowns are interpreted as accessory shearing edges. — Author's abstract

**Jennings, Ted V.** *See* Hoppin, Richard A. 07374

**Jerabek, L. A.** *See* Novitzki, R. P. 07233

00093 **Jessop, A. M.** How to beat permafrost problems: Oilweek, v. 20, no. 47, p. 22, 24-25, illus., 1970.

As the search for oil is extended into permafrost areas, planners become more concerned with problems due to disturbance of permafrost by drilling, etc. It is not known where the lower boundary will be found in different wells. Some of the research being done on permafrost and heat flow includes subsurface-temperature measurement by thermistors in wells. Results from the Reindeer well in the Mackenzie delta are shown on a diagram; three or four years will be required for the well temperature to return to normal after drilling with heated fluid. Permafrost base will probably by 1195 feet ± 10 feet. — ESL

07125 **Johansen, Robert T.** Current status of nuclear explosive stimulation of natural gas reservoirs with thoughts on its effect on domestic gas reserves: Interstate Oil Compact Comm. Comm. Bull., v. 11, no. 2, p. 13-21, illus., tables, 1969.

Two experiments using nuclear explosives to stimulate low productivity gas formations have been performed. Production tests on the Gasbuggy test indicated a 5-fold increase in recovery compared to a conventionally stimulated well in the same formation. Fracturing was encountered during reentry of test wells at distances ranging from 400-700 feet from the point of detonation. Permeability of these fracture systems remained low. Contamination of the produced gas with radioactive materials was less than expected, with most in the form of tritium and krypton 85. Results of tests were encouraging enough to support detonation of the second underground explosion in a deeper gas sand having commercial possibilities. Production tests on this (Project Rulison) are being deferred until radioactivity decays. — *from* Author's abstract

**Johnson, Arvid M.** *See* Pollard, David D. 07453

07390 **Johnson, David A.; Smith, Stuart M.** Detailed survey of lineated topography in the eastern Pacific Ocean [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 116, 1969.

**Johnson, G. G., Jr.** *See* Hanawalt, J. H. 07249

**Johnson, G. Leonard.** *See* Watson, Jerry A. 00083

**Johnson, G. Leonard.** *See* Vogt, Peter R. 07055

07391 **Johnson, G. Leonard.** Sedimentary outer ridges in the North Atlantic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 116, 1969.

07392 **Johnson, Kenneth G.** The depositional system concept — A vehicle for secondary level earth science instruction [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 116-117, 1969.

**Johnson, Lynn E.** *See* MacNish, Robert D. 07242

07220 **Johnson, William D., Jr.; Smith, Avery E.** Geologic map of the Sutherland quadrangle, Daviess County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-839, scale 1:24,000, section, text, 1969.

Economic resources of the Sutherland quadrangle are petroleum from several fields in Tar Springs, Hardinsburg, Cypress, Waltersburg, and "Jackson" Sandstones. Coal has been mined for local use at several localities. — MCM

**Johnston, F.** *See* Dryer, H. T. 07254

07393 **Jolly, Wayne T.** Metamorphic alteration of the Robles Formation, south central Puerto Rico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 117, 1969.

07760 **Jones, D. L.; Bailey, E. H.; Imlay, R. W.** Structural and stratigraphic significance of the *Buchia* zones in the Colyear Springs-Paskenta area, California: U.S. Geol. Survey Prof. Paper 647-A, p. A1-A24, illus., tables, 1969.

A continuous sequence of Late Jurassic to Early Cretaceous sedimentary rocks is exposed in the northwestern Sacramento Valley, Calif. These rocks, which form the basal part of the Great Valley sequence, can be subdivided into six biostratigraphic zones based on the pelecypod *Buchia*. In the southern and central part of the area, the rocks are in fault contact with coeval but metamorphosed Franciscan rocks; in the northern part, they rest depositionally on older rocks of the Klamath Mountains. Three northwest-trending faults cut the Great Valley sequence and separate the strata into four discrete blocks. No distinctive lithologic units can be traced from one block to another, but *Buchia* zones can be mapped in all but the northern block. Analysis of distribution, thickness, and lithology of *Buchia* zones shows that unlike but coeval sequences have been juxtaposed along the faults by differential movements within the upper plate during thrust faulting. — DLJ

**Jones, J. Allan.** *See* Menzer, Fred J., Jr. 07439

**Jones, M. B.** *See* Cheney, E. S. 00145

**Jones, Robert L.** *See* Ahmad, N. 07728

07394 **Jonson, David C.; Davidson, Donald A.; Smithers, B. C.; Daughtry, Kenneth L.** The Hudson Bay Mountain molybdenum deposit, Smithers, British Columbia, Canada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 117-118, 1969; Econ. Geology, v. 64, no. 7, p. 833-834, 1969.

07151 **Judd, Robert W.; Nisbet, Jerry J.** Pennsylvanian coal ball flora of Indiana: Indiana Acad. Sci. Proc. 1968, v. 78, p. 120-138, illus., tables, 1969.

This is the first comprehensive study of fossil plants of the Pennsylvanian Period found in coal balls, which are specialized calcium carbonate concretions sometimes found in coal seams. Specimens from southwestern Indiana were studied, utilizing the "peel technique". Five divisions of plants, including 27 genera, classified according to the Andrews system, were represented. Only minor differences in genera were found in a comparison of Pennsylvanian plant assemblages of Indiana and Illinois, suggesting that a relatively uniform flora existed in portions of those states during that period. — *from* Authors' abstract

07747 **Jumikis, Alfreds R.** Experimental studies on moisture transfer in a silty soil upon freezing as a function of porosity: Rutgers Univ. (New Brunswick, N. J.) College Eng., Eng. Research Bull. 49, 71 p., illus., 1969.

This report represents 20 years of systematic study and freezing experiments on frost-prone soil systems composed of silt at various porosities. The research has led to identification of a consistent set of relationships, shown in graphical form, between porosity and the amount of moisture transferred during freezing, permeability, thermal conductivity, streaming potential induced during freezing, and frost penetration depth. The amount of soil moisture transferred upon freezing from "ground water" to the cold front is greater at lower porosity of the soil, because moisture transfer in the vapor phase is ineffective as compared with that transferred by way of the film mechanism, most effective in low-porosity soils. — ESL

**Kaesler, Roger L.** *See* Koepnick, Richard B. 07633

**Kahn, Mohammad Asadullah.** *See* Woollard, George P. 00213

07395 **Kajiwara, Yoshimichi.** Experimental study of sulfur isotope fractionation between coexistent sulfide minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 118, 1969.

**Kalinin, V. A.** *See* Zharkov, V. N. 07059

**Kam, William.** *See* Signor, D. C. 00077

07396 **Kaneps, Ansis G.** Late Neogene (late Miocene to Recent) stratigraphy of the outer margin of the Blake Plateau [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 118-119, 1969.

07397 **Kaplan, I. R.** Significance of organic chemical and isotope analyses of extraterrestrial samples [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 119, 1969.

**Kaplan, I. R.** *See* Presley, B. J. 07456

07237 **Kauffman, Erle G.** Cretaceous marine cycles of the Western Interior: Mtn. Geologist, v. 6, no. 4, p. 227-245, illus., 1969.

Vertical sequences of lithologies and faunas in the center of the Western Interior basin depict all developmental stages of two major cycles, with lesser fluctuations producing interbedding. Close repetition of lithologies and faunas demonstrates environmental cyclicity during the Cretaceous, suggesting that the system may be modeled utilizing all parameters. This model may be applied to the solution and prediction of paleoenvironments and sedimentary-faunal sequences in unstudied parts of the basin. Initial interpretations define four major marine and marginal marine basin environments. Data suggest the manner in which the basin evolved. Interpretation by following time zones of the Greenhorn and Niobrara cycles from the center to the strand support the above. — ESL

07398 **Kauffman, Erle G.; Beauchamp, Robert G.** Sediments and faunas of Paleocene marine cycles, Potomac River valley [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 119-120, 1969.

07126 **Kaufman, M. I.; Rydell, H. S.; Osmond, J. K.** $^{234}U/^{238}U$ disequilibrium as an aid to hydrologic study of the Floridan aquifer: Jour. Hydrology, v. 9, no. 4, p. 374-386, illus., table, 1969.

Investigation of the distribution and environmental disequilibrium patterns of naturally occurring uranium isotopes (U-234, U-238) in waters of the Floridan aquifer in north Florida, using isotope dilution and alpha-particle spectrometry, indicates that variations in isotopic activity ratios and concentrations can be related to the regional hydrogeologic framework. Data permit interpretation in terms of regional permeability characteristics, including existence of hydrologic barriers; groundwater circulation patterns; sources of waters from various parts of the hydrologic environment; and areas of extensive Pleistocene leaching within the Floridan aquifer. — *from* Authors' abstract

00088 **Kaushal, Sushil K.; Wetherill, George W.** Rubidium 87-strontium 87 age of carbonaceous chondrites: Jour. Geophys. Research, v. 75, no. 2, p. 463-468, tables, 1970.

Nine carbonaceous chondrites have been analyzed for K, Rb, and Sr concentrations and Sr isotopic composition; two others were analyzed for K and Rb only. Possibly because of contamination, Orgueil and Ivuna (type 1) and Cold Bokkeveld and Erakot (type 2) do not fall on the bronzite isochron, which has an age of 4.69 b.y.; Haripura, Mokoia-B, Essebi, Mighei, and Pueblito de Allende (types 2,3, and 4) fall on the bronzite isochron within experimental error. There is no evidence to support

the suggestion that the type 3 carbonaceous chondrites were formed by metamorphism of type 1 by Rb depletion 300 m.y. later. Rb and Sr elemental variations show an opposite trend. Rb and K concentrations are higher and Sr lower in type 1 than in types 2 and 3. The K/Rb ratio in carbonaceous chondrites is almost uniformly distributed at about 240. — DBV

07399 **Kay, Marshall.** Long Point Formation and Taconian orogeny in western Newfoundland [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 120, 1969.

**Kaye, Maureen.** *See* Taylor, S. R. 07364

**Kays, Olaf.** *See* Moody, D. W. 07687

**Keefer, Thomas N.** *See* McQuivey, Raul S. 07627

**Keefer, W. R.** *See* Love, J. D. 07613

**Keller, George H.** *See* Richards, Adrian F. 00177

**Keller, George H.** *See* Richards, Adrian F. 07467

07170 **Keller, W. D.** Chemistry in introductory geology (4th edition): Columbia, Mo., Lucas Brothers Publishers, 108 p., illus., tables, 1969; originally published 1957.

The purpose of this booklet is to provide in easy-to-read language, a simplified approach to chemical concepts used most commonly in introductory geology and to illustrate the concepts with practical geologic examples for the geology student with no previous course in chemistry and for a review of simple geological chemistry. Section headings are: materials of the Earth in terms of elements, atoms, ions, and compounds; chemical processes in geology; magma and its products; chemical weathering; deposition of chemical sediments; colloids in geology; chemical reactions in metamorphism; deposition of ore minerals; rock cycle; and mineral age and environmental history from isotopes. A subject index is appended. — MCM

**Keller, W. D.** *See* Snetsinger, Kenneth G. 07204

**Keller, W. D.** *See* Huang, W. H. 07380

07650 **Kelley, Dana R.; Lytle, William S.; Wagner, Walter R.; Heyman, Louis.** Oil and gas developments in Pennsylvania in 1968: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 177, 48 p., illus., tables, 1969.

Oil and gas developments in Pennsylvania in 1968 included extensive development in Upper Devonian gas fields in several counties, indicating gas and oil prospects are far from exhausted; excellent gas production from a fractured Onondaga-Oriskany reservoir in Cambria County; increasing volume of Corning-grade crude oil in association with gas from Medina sandstone of Crawford and Erie Counties; and oil discoveries in Forest and Warren Counties and gas in Somerset and Washington Counties. Crude oil production decreased 7 percent from 1967, and gas decreased about 2 million MCF. Seismic activity has increased and interest in subsurface disposal of industrial effluents has expanded. — *from* Author's abstract

07654 **Kelley, Dana R.** A summary of major geophysical logging methods: Pennsylvania Geol. Survey, 4th ser., Bull. M 61 (Mineral Resources Rept.), 82 p., illus., tables, 1969.

This report reviews major subsurface geophysical logging methods available domestically. Basic principles of the methods, effects to be considered from their evaluation, and their uses are summarized in text, figures, and tables. In the presentation of this type of generalized compilation of geophysical logging, the type of subsurface information is stressed rather than geophysical principles upon which the methods are based, to enable the reader to appreciate readily methods available. The resumé is directed and related to Pennsylvania and immediately surrounding areas; improved

appreciation of geophysical logging services and engineering advice is stressed. The bibliography affords a source for more specific and detailed information.—*from* Author's abstract

**Kellner, Earl.** *See* Margolis, Stanley V. 07429

**Kellogg, William C.** *See* Hood, Peter J. 07270

**Kempton, John P.** *See* McComas, Murray R. 07277

**Kennedy, G. C.** *See* Hariya, Y. 07200

**Kennedy, George C.** *See* Ito, Keisuke. 07386

**Kennedy, George C.** *See* Akella, Jagannadham. 07559

**Kennedy, M. J.** *See* Coates, H. J. 00147

07216 **Kepferle, Roy C.** Geologic map of the Samuels quadrangle, north-central Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-824, scale 1:24,000, text, 1969.

Economic resources of the Samuels quadrangle are limestone and dolomite from the Louisville Limestone and Laurel Dolomite, and dimension stone from the Laurel and from the lower part of the Borden Formation. — MCM

07401 **Kerrick, D. M.** Stability relations of some common metamorphic calc silicate assemblages [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 123, 1969.

07402 **Kesler, Stephen E.** Significance of marble belts to structural and stratigraphic problems in nuclear Central America [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 123-124, 1969.

07051 **Khain, V. E.; Muratov, M. V.** Crustal movements and tectonic structure of continents, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 523-538, illus., geol. map, 1969.

The types of tectonic movements responsible for crustal deformation in platform and geosynclinal regions are reviewed. Among the data, it is particularly emphasized that vertical and horizontal movements cannot be considered independently. The deformational processes involve repeated conversion of vertical stresses in the tectonosphere (crust and upper mantle) into horizontal stresses which, in turn, are responsible for vertical displacements at a higher level. — MS

07077 **Khan, M. A.** Figure of the Earth and mass anomalies defined by satellite orbital perturbations, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 293-304, illus., tables, 1969.

Hydrostatic models and equations for the actual and equilibrium figures of the Earth are derived, based in large part on space-oriented geometric methods involving artificial Earth satellites. Satellite representations of the gravity field reveal regional areas of anomalies that may be either an expression of deep-seated masses or the integrated effect of a number of shallow mass anomalies in the upper mantle or crust. The anomalous gravity field of the Mid-Atlantic Ridge area conforms closely with apparently compensated regional topographic relief, whereas in the Indian Ocean area the broad negative anomaly is apparently related to a stable ocean basin. The data indicate that although isostasy is a factor, much of the anomalous gravity vector originated in the upper mantle. — MS

00164 **Khoury, S. G.; Abdel-Khalek, M. Lotfi.** Effect of a Precambrian orogeny on some layered rocks in the Piedmont of central Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 26, 1970.

07223 **Kidder, Gerald; Reed, L. W.** Swelling characteristics of hydroxy-aluminum interlayered clays [abs.]: Oklahoma Geology Notes, v. 29, no. 6, p. 152-153, 1969.

07403 **Kilbourne, Richard T.** The use of sessile Foraminifera for the recognition of diastems in the geologic record [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 124, 1969.

07404 **Kilinc, I. A.; Lyon, R. J. P.** Airborne infrared spectral study of igneous rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 125, 1969.

00165 **Kim, Ann G.** Geochemistry of methane formation in coal—[Pt.] 1, Microbial generation [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 26-27, 1970.

07244 **Kim, Stephen M.; Ruch, R. R.** Low level liquid scintillation counting for radiocarbon dating [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 643, 1969.

07245 **Kim, Stephen M.** Labelling of benzene with hydrogen and carbon isotopes — A multipurpose advanced laboratory experiment [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 644, 1969.

07405 **King, Elizabeth R.; Zietz, Isidore.** The midcontinent gravity high — Keweenawan tectonics and a possible ancestral global rift system [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 125-126, 1969.

07130 **King, Philip B.** Voprosy tektoniki Severnoy Ameriki: Moscow, Izdatel'stvo Moskov. Univ., 179 p., illus., 1969.

In addition to Russian translations (by N. A. Bogdanov and N. V. Koronovskiu) of four papers originally published in English, dealing respectively with the tectonic framework of the southeastern United States (Virginia Polytch. Inst. Dept. Geol. Studies Mem. 1, p. 5-31, 1964), North American Cordillera (Canadian Mining and Metallurgy Spec. Vol. 8, p. 1-25, 1966), anatomy and habitat of low-angle thrust faults (Am. Jour. Sci., v. 258-A, p. 115-125, 1960), and Quaternary tectonics in middle North America (*in* The Quaternary of the United States, p. 831-870, 1965), this book contains a Russian translation of one of eight lectures given in October 1965 at the University of Moscow; the lecture dealt with the Paleozoic sedimentational and tectonic evolution of the Marathon fold-belt region in west Texas. — MS

07323 **King, Roger Hatton.** Periglaciation on Devon Island, N.W.T. [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2246B, 1969.

**Kipp, Nilva.** *See* Imbrie, John. 07385

07329 **Kirkham, Rodney Victor.** A mineralogical and geochemical study of the zonal distribution of ores in the Hudson Bay Range, British Columbia [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2251B, 1969.

**Kirkwood, Samuel.** *See* Swain, Frederick M. 07750

07406 **Kissling, Don L.** Ecology of Silurian crinoid-root bioherms [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 126, 1969.

**Kistler, R. W.** *See* Evernden, J. F. 00208

07247 **Klein, David H.** Mercury in the marine environment [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 647, 1969.

00117 **Knisel, Walter G., Jr.; Baird, Ralph W.** Depth-integrating and dip samplers: Am. Soc. Civil Engineers Proc., v. 96, paper 7084, Jour. Hydraulics Div., no. HY 2, p. 497-507, illus., table, 1970.

Comparative tests of depth-integrating and dip samplers were made for fine-grained suspended sediment. Approximately 60 percent of the suspended load was 2-$\mu$ and

smaller in size. Differences between suspended-sediment concentrations obtained with dip samplers and depth-integrated samplers were statistically significant. Concentrations of depth-integrated samples averaged 1.02 percent greater than concentrations of dip samples. — Authors' abstract

07073 **Knopoff, Leon.** Attenuation of seismic waves in the mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 273-276, 1969.

Attenuation factors can be measured by standing wave and propagating wave experiments. The dimensionless specific attenuation factor obtained by these methods is not the same; in the former method the attenuation factor per unit period is obtained, and in the latter, the attenuation factor per unit wavelength. Both values are related by the ratio of mean phase velocity and group velocity. Various problems that still remain to be solved are briefly noted. — MS

07160 **Knopoff, Leon.** Continental drift and convection, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 683-689, illus., 1969.

Geophysical evidence of flow in the mantle and the scale of mantle motions, as well as analysis of models of the driving mechanism, indicates that mantle-wide convection is improbable and lends support to the view that convection is not a steady-state process. Given episodic motion, the source of instability is to be found in the static episode, and stresses responsible for sea-floor spreading are probably thermal in character. — MS

**Knott, S. T.** *See* Emery, K. O. 00099

07407 **Koch, George S., Jr.; Link, Richard F.** The coefficient of variation — A guide to the sampling of ore deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 126-127, 1969; Econ. Geology, v. 64, no. 7, p. 834, 1969.

07633 **Koepnick, Richard B.; Kaesler, Roger L.** Statistical analysis of intraspecific variation of morphology of *Triticites cullomensis* [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 127, 1969.

07408 **Kohn, J. A.; Eckart, D. W.** Evidence for a mineral series in the plumboferrite group [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 127-128, 1969.

07257 **Koirtyohann, S. R.; Pickett, E. E.** The role of flame shape and burner configuration in emission analysis: Appl. Spectroscopy, v. 23, no. 6, p. 597-600, illus., tables, 1969.

A simple derivation can show that the effect of flame shape, multiple flames, and multi-pass optical systems should be the same for flame emission intensity as for atomic absorption response. Experimental evidence confirms the prediction and shows that the steps used to increase atomic absorption response are directly applicable to emission measurements. Increased emission intensities reduce noise levels and lower detection limits by lowering the required electrical gain and by permitting the use of narrower spectrometer slits. The improvement in detection limits from the use of narrow slits depends on the background structure in the vicinity of the line. Three cases are considered in detail. — Authors' abstract

07102 **Kosminskaya, I. P.** Explosion seismology — Introduction, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 177, 1969.

Deep seismic sounding has been applied to studies of the regional structure at depth of large areas of the USSR and to analysis of the structure of smaller crustal blocks (less than 200 km wide), and intervening fault zones. Details of the technique differ depending on the purpose for which it is used. — MS

07573 **Kottlowski, Frank E.; Weber, Robert H.; Willard, Max E.** Tertiary intrusive-volcanic-mineralization episodes in the New Mexico region [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 278-280, 1969.

**Koucky, Frank L.** *See* Drafall, Larry E. 07568

07620 **Koyanagi, Robert Y.** Hawaiian seismic events during 1968, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D168-D171, illus., 1969.

In Hawaii, 699 earthquakes having a magnitude of from 2.0 to 4.7 were recorded in 1968. Seismic activity continued beneath southeastern Hawaii during the year with prolonged volcanic eruptions and associated structural adjustments. — Author's abstract

07409 **Krumbein, W. C.** Probabilistic models and the quantification process in geology [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 129, 1969.

07410 **Kullerud, Gunnar.** Sulfide phase relations [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 130-131, 1969.

**Kulm, L. D.** *See* Spigai, J. J. 07501

**Kulm, L. D.** *See* Fowler, Gerald A. 07571

00166 **Kumar, Naresh; Sanders, John E.** Geologic implications of migration of Fire Island Inlet [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 27, 1970.

**Kumar, Naresh.** *See* Sanders, John E. 00178

07726 **Kunkler, J. L.** Measurement of atmospheric pressure and subsurface-gas pressure in the unsaturated zone of the Bandelier Tuff, Los Alamos, New Mexico, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D283-D287, illus., 1969.

Pressure transducers, power supplies, and potentiometric recorders were assembled into portable pressure-monitoring systems which measured pressures in the field with an accuracy of about 0.3 percent. The performance of some of the components was affected by fluctuations in field temperatures; hence these components were operated in a constant-temperature chamber. The data from this study show that the subsurface-gas pressures responded to changes in the atmospheric pressure to depths of 35 meters in the Bandelier Tuff; the response was completely attenuated at some depth between 35 and 89 m. — Author's abstract

07060 **Kuno, Hisashi.** Plateau basalts, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 495-501, illus., table, 1969.

Plateau basalts consist of rocks ranging from tholeiites to alkalic olivine basalts, derived from highly differentiated magma, whose extrusion was not due to concentration of heat energy within a limited region of the upper mantle but to a protracted supply of heat energy over a wide region. Rate of extrusion is essentially similar to that of island-arc volcanism. Calculations of thickness and areal distribution yield values suggesting that magma generation involved repeated melting of small volumes of mantle peridotite. — MS

07062 **Kuno, Hisashi.** Mafic and ultramafic inclusions in basaltic rocks and the nature of the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 507-513, illus., 1969.

This paper is largely concerned with the mineralogy and major element contents of these inclusions, their depth relations and origin, and the constitution of the upper mantle as deduced from the inclusion study. — MS

07064 **Kuno, Hisashi.** Age relationships of the Precambrian basement rock complex, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 519, 1969.

Absolute age determinations permit dating of Precambrian metamorphic and intrusive complexes associated with different orogenic events and will ultimately provide a basis for correlations that will throw light on the origin and growth of continents. — MS

**Kunzendorf, H.** *See* Lövborg, L. 07740

07411 **Kupfer, Donald H.** The deformation diagram and sea floor spreading [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 131, 1969.

07412 **Kutner, Philip.** Initial observations on team-testing ESCP [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 131-132, 1969.

**Kuykendall, W. E.** *See* Santos, G. G. 07742

07413 **Kvenvolden, Keith A.; Peterson, Etta.** Amino acid enantiomers in Green River Formation oil shale [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 132-133, 1969.

**Lahann, Richard W.** *See* Moore, D. M. 07578

07648 **Lai, Sung-ho; Swindale, L. D.** Chemical properties of allophane from Hawaiian and Japanese soils: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 804-808, illus., tables, 1969.

Fine clay fractions and coarse clay fractions were obtained from moderately to strongly weathered soils derived from volcanic ash in Hawaii and Japan. Most fine clay fractions and one coarse clay fraction were X-amorphous and had differential thermograms characteristic of allophane. The apparent crystallinity of fine clays as determined from X-ray data correlated well with the area of the low temperature endotherm in DTA and with the change in CEC (ΔCEC) from pH 8.5 to pH 4.0. Silica-alumina molar ratios of fine clays varied from 0.93 to 1.50; ratios for the three least crystalline fractions were all close to 1.0. The proportion of silica to alumina correlated with loss on ignition, with ΔCEC, and with position of the main infrared absorption band. These correlations probably reflect changes in coordination state and suggest some stabilized $Al^{IV}$-O-$Al^{IV}$ bonds in the allophane. — *from* Authors' abstract

07634 **Lajoie, Kenneth R.** Pleistocene lacustrine history of Mono Basin, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 133, 1969.

07574 **Lamb, James L.** Planktonic foraminiferal datums and late Neogene epoch boundaries in the Mediterranean, Caribbean, and Gulf of Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 280-281, table, 1969.

07201 **Langer, K.; Schreyer, W.** Infrared and powder X-ray diffraction studies on the polymorphism of cordierite, $Mg_2(Al_4Si_5O_{18})$: Am. Mineralogist, v. 54, nos. 9-10, p. 1442-1459, illus., table, 1969.

Devitrification products of pure Mg-cordierite glass, obtained at 980° and 1400°C, were studied. For a characterization of early stages of the structural transition from high- to low-cordierite, a new width index was found to be a more sensitive X-ray parameter than the distortion index Δ. The glass, metastable high-quartz structure, and cordierite structure in general, yield characteristic infrared spectra. Only early stages of the transition with width indices corresponding to Δ values up to 0.10°-0.17° show concomitant variations of spectra typical for short-range ordering processes; later stages can be defined solely by their X-ray properties and may be due to increasing long-range order. Orthorhombic distortion of cordierite appears to depend on both short- and long-range order and hence, distortion index Δ cannot be used as a measure of degree of Si/Al order. — *from* Authors' abstract

07414 **Langmuir, Donald.** Saturation with calcite and dolomite of some ground waters in folded and faulted carbonate rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 133-134, 1969.

**Lanphere, M.A.** *See* Brosgé, W.P. 07721

**Lanphere, Marvin A.** *See* Dalrymple, G. Brent. 07177

**Larson, R. L.** *See* Chase, C. G. 00209

07116 **Latter, J. H.** Natural disasters: Adv. Sci., v. 25, no. 126, p. 362-380, illus., tables, 1969.

The casualty rate in earthquakes, 8 to 10 times that in volcanic eruptions until 1949, has fallen off with anti-seismic constructions. Volcanic eruptions have a more profound effect on people drawn to the fertile soils, for example the Santorini events in the Mediterranean, B.C. 1400 and Merapi eruption in Java, A.D. 1006. Earthquakes are most frequent disasters with most casualties in the densely populated Himalayan-Mediterranean zone. Volcanic eruptions can be predetermined, but not yet time predicted. Extensive Tertiary and Pleistocene ignimbrites indicate the greatest danger in such rapidly spread flows; historically, the only such possibility, Katmai in 1912, had few casualties. In potentially active areas, pre-eruptive signs — fumarole changes, landslides, and seismic swarms — are recorded under network surveillance; draining of crater lakes, use of explosives, and evacuations reduce dangers of mudflows and violent events. — GDC

07589 **Lea, Graham.** Markov forecasting techniques in exploration [abs.], *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 5, 1969.

**Learned, Robert E.** *See* Hinkle, Margaret E. 07629

**Lee, W. H. K.** *See* VonHerzen, R. P. 07093

**LeGrand, H. E.** *See* Stringfield, V. T. 07111

07306 **Lehner, Peter.** Salt tectonics and Pleistocene stratigraphy on continental slope of northern Gulf of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2431-2479, illus., tables, 1969.

During a sparker and core-drill program by Shell, salt was cored on 10 prominent structures on the continental slope. Broad salt swells and pillows are typical structures in this region. The Sigsbee scarp appears to be the surface expression of a salt front. A zone of active down-to-the-ocean faults follows the Texas shelf edge. They appear to be related to the flow of salt at depth away from the advancing clastic wedge. Upper Cretaceous through Holocene deep-water sediments were cored on the continental slope. East of Brownsville the salt is overlain by redbeds of unknown age. Core holes at the shelf edge penetrated deltaic and shoreline deposits of the Pleistocene low-sea-level stages. Submarine slides and turbidity currents carried sediments down the slope and filled deep synclinal basins between the salt uplifts. — *from* Author's abstract

**Lehr, James R.** *See* McClellan, Guerry H. 07196

00104 **LeMasurier, Wesley E.** Structural study of a Laramide fold involving shallow-seated basement rock, Front Range, Colorado: Geol. Soc. America Bull., v. 81, no. 2, p. 421-434, illus., 1970.

A plunging anticline west of Loveland, Colo., exposes Precambrian basement rock in its core, permitting a study of fold mechanisms within the en echelon fold belt of the Colorado Front Range. Sedimentary rocks yielded to stress by concentric folding, up to a limiting curvature, and by faulting thereafter. Basement rocks adjusted to stresses by differential movement along pre-existing factures within a zone adjacent to the unconformity. — AG

00079 **Lemmon, Richard M.** Chemical evolution: Chem. Rev., v. 70, no. 1, p. 95-109, illus., tables, 1970.

Chemical evolution has come to mean the chemical events that took place on the primitive, prebiotic Earth leading to the appearance of the first living cell. Results and implications of experiments performed over the last two decades are reviewed. Discussion of abiogenic synthesis on the primitive Earth is divided into the time scale, the atmosphere, and other conditions. Experiments on abiogenic synthesis of biomonomers have resulted in appearance of the following molecules important in living systems — at least 15 of the 20 amino acids, 4 of the 5 nucleic acid bases, and 2 of the 3 sugars. Synthesis of the biopolymers, proteins and nucleic acids, is discussed also. — ESL

**Lennon, Kenneth D.** *See* Hodgson, Gordon W. 07762

07191 **Leonard, B. F.; Desborough, George A.; Page, Norman J.** Ore microscopy and chemical composition of some laurites: Am. Mineralogist, v. 54, nos. 9-10, p. 1330-1346, tables, 1969.

Quantitative ore-microscopic properties of laurite [ruthenium sulfide] are defined from a study of five specimens from Borneo; Goodnews Bay, Alaska; and the Stillwater Complex, Montana. It is white, rather bright, isotropic, hard, probably having {001} parting, and is negative to standard etch reagents. Microprobe analyses indicate that a series of laurites exists between observed extreme members. As Ru in laurites decreases, both Ir and Os increase. Similar compositional variation is shown by an unidentified platinoid alloy that accompanies Goodnews Bay laurite. The rather large change in composition, in which Ir + Os proxies for 0.4 Ru atom, produces slight but measurable changes in the quantitative properties of these laurites. The high microindentation hardness of laurite seems to distinguish the species from other optically isotropic minerals. — *from* Authors' abstract

**LePichon, Xavier.** *See* Talwani, Manik. 07079

07415 **Lerman, Abraham.** Some chemical equilibria in chloride brines [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 134, 1969.

07416 **Levinton, Jeffrey S.; Bambach, Richard K.** Silurian and Recent deposit feeding bivalve communities — A comparative study [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 134-135, 1969.

07318 **Levy, Roy.** Random processes for earthquake simulation [abs.]: Dissert. Abs. International., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2157B, 1969.

**Lewis, Glenn C.** *See* Park, Robert G. 07748

07594 **Lewis, James O.** Practical computer usage for subsurface geologists [abs.], *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 41, 1969.

07146 **Lewis, Laurence A.** Analysis of surficial landform properties — The regionalization of Indiana into units of morphometric similarity: Indiana Acad. Sci. Proc. 1968, v. 78, p. 317-328, illus., tables, 1969.

This study offers an alternative to the traditional reliance on qualitative data and the subjective approach in the regionalization of geomorphic units. The results of a principal components analysis and a cluster analysis indicate that geomorphic units developed for Indiana can be regionalized using three primary morphometric components: a vertical component, an areal magnitude factor, and a streamwork development factor. A lacustrine factor is found to be of secondary importance within Indiana. The areal patterns of these components indicate that the previous physiographic or regional geomorphic units developed for Indiana fail in delimiting the State into regions of form similarity, probably because previous investigations concentrated on geologic structure and/or process rather than on actual topographic expression. — *from* Author's abstract

07281 **Libby, W. F.** Radiocarbon dating: Chemistry in Britain, v. 5, no. 12, p. 548-552, illus., table, 1969.

During its life of 8300 years, cosmic radiocarbon mixing with air and ocean enters all living things by photosynthesis; most of it is produced in the stratosphere. The first clue to C-14 dating came in 1939 from a peak neutron intensity detected by balloons at 10 miles altitude. Early experiments with methane and the development of a counting method are described; deactivation of penetration rays solved counting problems. Radiocarbon dating on simultaneity is reliable, but on absolute age it can be incorrect by 600-700 years. Bristlecone pine chronology, now known back to 7500 years, by check with radiocarbon dates, may be extended to 10,000. Deviation in tabulated activity of terrestrial biosphere samples seems due to a weakening of the Earth's magnetic field. Moon samples allow more accurate measurement of cosmic ray intensities. — GDC

07312 **Lieberman, Kenneth Warren.** The determination of bromine in terrestrial and extraterrestrial materials by neutron activation analysis [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2058B, 1969.

07253 **Liese, Homer C.** Compositions of selected minerals — A combined spectroscopic approach [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 674, 1969.

**Link, Richard F.** *See* Koch, George S., Jr. 07407

07417 **Liou, J. G.** Synthesis and stability relations of prehnite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 135, 1969.

07606 **Lipman, Peter W.; Mutschler, Felix E.; Bryant, Bruce; Steven, Thomas A.** Similarity of Cenozoic igneous activity in the San Juan and Elk Mountains, Colorado, and its regional significance, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D33-D42, illus., 1969.

Upper Cenozoic igneous rocks of the San Juan Mountains region are predominantly volcanic, whereas those of the Elk Mountains region are largely epizonal plutonic; yet the age and sequence of petrologic types are strikingly similar in the two areas. In both, rocks of intermediate composition were emplaced in large volume during the Oligocene; these were followed during the Miocene, Pliocene, and Pleistocene by a less voluminous bimodal assemblage of mafic and silicic rocks. This sequence seems to characterize middle and late Cenozoic igneous activity of much of the southern Rocky Mountains, with the change from intermediate to bimodal igneous activity coinciding approximately with beginning of block faulting related to late Cenozoic crustal extension. — Author's abstract

07664 **Little, H. W.; Smith, A. Y.** Techniques currently used in uranium prospecting in Canada, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 131-145, illus., table, discussion, 1969.

The sequence in the search for uranium deposits in Canada begins with establishment of a factual classification of types of deposits and criteria for recognition of the geologic environment favorable to each type. Next is a careful appraisal of geologic maps and reports to determine regions or formations in which these criteria exist. After selection of a favorable region, initial field investigation is preceded by airborne scintillometer or gamma-ray spectrometer surveys, and then by detailed geologic mapping. Detailed scintillometer grid surveys on the ground are used to pinpoint targets for trenching or diamond drilling. Scintillometer probes are used in drill holes to extrapolate chemical assay data. Various types of geologic, geochemical, and geophysical research are being conducted by both government and private groups on new and improved techniques of exploration. — VSN

07418 **Livingston, Donald E.** The chronology and initial strontium isotope ratios of older Precambrian rocks in the Gila County region, Arizona [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 135-136, 1969.

00110 **Lofgren, Gary.** Experimental devitrification rate of rhyolite glass: Geol. Soc. America Bull., v. 81, no. 2, p. 553-559, illus., table, 1970.

Experimental devitrification of natural rhyolite glass has shown that the devitrification rate is increased significantly if Na- or K-rich solutions are present. This increased devitrification rate is accompanied by a change in the $Na_2O/K_2O$ ratio in the devitrified product in favor of the alkali in the solution. — Author's abstract

07419 **Loney, Robert A.; Himmelberg, Glen R.** Structure of the alpine-type peridotite at Burro Mountain, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 136, 1969.

**Loney, Robert A.** *See* Brew, David A. 07603

07420 **Long, Leon E.; Clemons, Russell E.** Rb-Sr isotope study of the Chiquimula pluton, Guatemala [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 137, 1969.

07308 **López-Ramos, Ernesto.** Marine Paleozoic rocks of Mexico: Am. Assoc. Petroleum Geologists Bull., v. 53, no. 12, p. 2399-2417, illus., tables, 1969.

Up to 3500 m of marine Paleozoic carbonates and shales fill Sonora and Chihuahua basins (northwest and north-central Mexico), the Paleozoic geosyncline (from western Coahuila to Oaxaca), and the Chiapas-Guatemala basin (southeastern Mexico). Cambrian, Ordovician, Silurian and Devonian rocks are scarce, discontinuous, and mostly in northern Mexico; Mississippian and Pennsylvanian rocks are widespread but thickest in northern and central Mexico; and Permian rocks are most widespread but thickest in the Paleozoic geosyncline and the Chiapas-Guatemala basin. Paleozoic rocks are drilling objectives in north-central Mexico. — BHK

00086 **LoPinto, Victor J.** Field studies of response of peat to plate loading — Discussion [of paper 6652 by J. B. Forrest and I. C. MacFarlane, 1969]: Am. Soc. Civil Engineers Proc., v. 96, Jour. Soil Mechanics and Found. Div., no. SM 1, p. 361-362, 1970.

As Forrest and MacFarlane indicate (ibid., v. 95, no. SM 4, p. 948-967, 1969), peats are among the poorest of foundation materials, but marginal peat areas are fast becoming the only available locations. LoPinto adds to the list of three construction methods above peat, the technique of controlled compacted fills either upon the moss surface mat or by excavating a minimum depth of peat, if necessary, and placing the fill upon that. — ESL

**Lorens, Phillip J.** *See* Huffman, Michael E. 07382

07740 **Lövborg, L.; Kunzendorf, H.; Hansen, J.** Use of field gamma-spectrometry in the exploration of uranium and thorium deposits in south Greenland, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 197-211, illus., tables, 1969; *reprinted as* Grönlands Geol. Undersögelse Misc. Paper 62, 1969.

The gamma-spectrometry method for field determination of U and Th has been studied by measurements with a portable gamma-spectrometer in the Ilímaussaq intrusion, south Greenland. The spectrometer consisted of a scintillation detector with a NaI(Tl) crystal and a single-channel pulse-height analyzer. Rock samples from field localities were crushed and spectrophotometrically analyzed for U and Th, and the gamma spectra were measured at the same time in the laboratory. For each field or laboratory gamma-spectrum, count rates in two energy bands covering the 1.764- and 2.615-MeV total absorption peaks were determined. Field and laboratory data were correlated with sample contents of U and Th from linear regression analysis. Fluctuations of field data about expected mean values of the data were very large, and were ascribed to heterogeneities characterizing distribution of U and Th in rocks. — *from* Authors' abstract

07613 **Love, J. D.; Keefer, W. R.** Basin Creek uplift and Heart Lake Conglomerate, southern Yellowstone National Park, Wyoming, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D122-D130, illus., 1969.

A major, but still largely buried structural feature, the Basin Creek uplift, and a previously undescribed sedimentary sequence, the Heart Lake Conglomerate (a new name in this report), provide new data for interpreting the geologic history of southern Yellowstone National Park. The uplift was initially folded at or near the close of Cretaceous time; in late Cenozoic time a major part of it, at least, was rapidly elevated. This later movement resulted in deposition of the Heart Lake Conglomerate, 70-330 feet thick, composed chiefly of Madison Limestone (Mississippian) fragments in a talc- and chlorite-rich matrix. The conglomerate may be of Pliocene or Pleistocene age. — Authors' abstract

07657 **Lowe, Barbara V.** The adventure of mineral collecting: Los Angeles County Mus. Nat. History Quart. v. 8, no. 1, p. 11-16, illus., 1969.

Several of the rare mineral specimens, or those with unusual histories, in the Los Angeles County Museum of Natural History collections are described and shown in color photos. — ESL

07421 **Lowell, James D.** On the origins of upthrusts [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 138, 1969.

00167 **Lowright, R. H.; Williams, E. G.** Light and heavy mineral settling velocity distributions in sands along southern Lake Erie [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 27-28, 1970.

07091 **Lubimova, E. A.** Thermal history of the Earth, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 63-77, illus., tables, 1969.

Analysis of various thermodynamic models with reference to the content of radioactive elements, thermal conductivity coefficients, initial and boundary conditions, and other parameters shows an excess of total heat production in the interior of the Earth relative to total heat flow throughout the Earth's history. Among other conclusions drawn from the analysis, it is noted that the premise of an iron core implies a significant gravitation differentiation energy in the mantle relative to radiogenic energy and that heat flow in certain crustal zones is closely related to the age of tectonic activity. — MS

**Lucchitta, Ivo.** *See* Bailey, N. G. 07621

07422 **Luce, Robert W.** Dissolution of magnesium silicates [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 138-139, 1969.

00120 **Lueck, Gail G.** Inquiry — Directed or open-ended,: Jour. Geol. Education, v. 18, no. 1 p. 40-42, 1970.

The two types of inquiry are defined and clarified by citing examples from an investigation of the Earth Science Curriculum Project; the importance of open-ended inquiry is stressed, especially within the earth sciences. The chief value of the open-ended approach is the need it develops in the student for self-reliance and self-motivation in learning. Two shortcomings are requiring too much time so that some work is omitted, and being applicable only to above-average students. The author has found that below-average students also operate effectively using the open-ended approach. An example is given of a study of effects of running water on sediment. Open-ended inquiry is applicable to all levels from elementary to graduate. — ESL

**Lukowsky, J. Ann.** *See* Ypma, Peter J. M. 07557

07423 **Lyall, Anil.** Differentiation of environments using a scanning electron microscope [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 139, 1969.

07575 **Lynts, George W.; Stehman, Charles F.** Deep-sea Eocene in Northeast Providence Channel, origin of Bahamas and sea-floor spreading [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 281-282, table, 1969.

**Lyon, R. J. P.** *See* Kilinc, I. A. 07404

07331 **Lyons, Paul Christopher.** Bedrock geology of the Mansfield quadrangle, Massachusetts [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2253B, 1969.

**Lytle, William S.** *See* Kelley, Dana R. 07650

07161 **Lyustikh, E. N.** Problem of convection in the Earth's mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad: Sci.-Natl. Research Council Pub. 1708), p. 689-692, 1969.

Various examples are given to demonstrate that theories of convection in the mantle do not support the hypothesis of continental drift. Whether convection exists in the mantle is still problematic. Ultimate solution of the problem is closely bound to solution of the problem of the composition of the Earth's core. Chemical convection may prove to be an important mechanism. — MS

07424 **MacClintock, Copeland.** Systematic position of the pre-Cenozoic gastropods *Metoptoma, Lepetopsis* and *Symmetrocapulus* [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 139-140, 1969.

07425 **MacClintock, Copeland; Pannella, Giorgio.** Time of calcification in the bivalve mollusk *Mercenaria mercenaria* (Linnaeus) during the 24-hour period [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 140, 1969.

00126 **MacDonald, Angus A.** The northern Mojave Desert's little Sahara: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 1, p. 3-6, illus., 1970.

Many of the Dumont Sand Dunes, in the Silurian Valley, north of Baker, are over 300 feet high, and some are 400; almost every type of active dune is present. Source of the sand was probably Pleistocene Lake Manley in Death Valley to the west, and smaller Lake Dumont. Some of the ephemeral streams probably supply sand also. Recorded data from Silver Lake indicate that most dune-building winds have been from the west, with secondary winds from the north and south. With this wind-pattern, dunes would be essentially nonmigratory. Some sand may be lost to the east. Findings, based on degree of roundness and frosting, bear out the theory that ingress of most sand was from the west and south. The bulk of dune growth has probably taken place within the past 18,000 years, and is continuing.—ESL

07426 **MacDonald Harold C.; Dellwig, Louis F.** Geologic interpretation of radar imagery from eastern Panama and northwestern Colombia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 140-141, 1969.

**Macdonald, J. R.** *See* Harksen, J. C. 07751

07427 **MacGregor, Ian.** An hypothesis for the origin of kimberlite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 141, 1969.

**MacKevett, E. M., Jr.** *See* Smith, James G. 00214

**MacKevett, E. M., Jr.** *See* Armstrong, Augustus K. 07722

07242 **MacNish, Robert D.; Heath, Ralph C.; Johnson, Lynn E.; Wilkens, Richard A.; Duryea, Richard D.** Bibliography of the ground-water resources of New York through 1967, with subject and location cross reference to the annotated bibliography: New York Water Resources Comm. Bull. 66, 186 p., illus., 1969.

07067 **Madden, T. R.; Swift, C. M., Jr.** Magnetotelluric studies of the electrical conductivity structure of the crust and upper mantle, *in* The Earth's crust and upper mantle:

Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 469-479, illus., tables, 1969.

The mathematical theory and problems of application of techniques involving measurement of the horizontal components of both electric and magnetic fluctuations in the crust and mantle are reviewed. To date, magnetotelluric results are too few and geographic coverage too limited for systematic formulation. The data give evidence of strong isotropies, indicative of lateral inhomogeneities, but these lateral variations cannot be defined for lack of horizontal coverage. They also show that the crust is more resistive than sedimentary rocks and a rapid decrease of resistivity with depth in the mantle. Further measurements and data analysis may ultimately permit calculation of the effect of temperature and pressure on conductivities, evaluation of the dynamic processes involved in producing anomalies, and conclusive interpretation of mantle composition and temperatures. — MS

07332 **Maddox, George Edward.** Geology and hydrology of the Roswell artesian basin, New Mexico [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2253B, 1969.

07159 **Magnitsky, V. A.** The transitional layer in the mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 676-682, illus., table, 1969.

Vertical gradients of velocities in the transitional zone (the C layer) separating the upper mantle (B layer) from the lower mantle (D layer) are large and cannot be explained solely by changes in chemical composition. Phase transitions of mantle materials under increasing pressure, involving transitions to more densely packed modifications and changes in the type of chemical bond, are considered a more likely explanation. — MS

07180 **Majewske, Otto P.** Recognition of invertebrate fossil fragments in rocks and thin sections: Leiden, Netherlands, E. J. Brill (Internat. Sed. Petrog. Ser., V. 13), 101 p., illus., tables, 1969.

Many marine invertebrates, recognizable as free, whole specimens, become unfamiliar when only portions of their skeletons are seen in thin section. A variety of shapes are produced by random cuts through a single geometric pattern, and shapes can be duplicated in such cuts by different designs; also, characteristic features may be obscured and others may become apparent when only skeletal fragments are exposed in one plane. In this volume, general descriptions and illustrative diagrams of skeletal morphology, mineralogy, and microstructure are given for some of the major animal phyla. Petrography of skeletal material is illustrated by photomicrographs [two-thirds of book] of Recent and fossil examples. Contents should permit tentative classification of shell fragments or similar material. — *from* Author's abstract

07081 **Malahoff, Alexander.** Gravity anomalies over volcanic regions, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 364-379, illus., tables, 1969.

Comparison of theoretical anomalies computed from geologic sections constructed as density models and terrain-corrected observed Bouguer anomalies yields gravity values that are diagnostic for study of the internal structure of volcanic features. Results of studies of gravity anomalies over the Hawaiian Ridge and other marine volcanic features and over Japan and other continental and island arc regions of volcanism are reported. — MS

07086 **Malahoff, Alexander.** Magnetic studies over volcanoes, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 436-446, illus., tables, 1969.

Both the magnetization of the volcanic cone or ridge and the magnetization of the volcanic plug are involved in magnetic anomalies associated with active, dormant, or extinct volcanic centers. The intensity of natural remanent magnetization

predominates over that of induced magnetization, and is much greater in basaltic than in andesitic volcanoes. Basaltic volcanoes are generally characterized by the presence of highly magnetized dike-filled plugs. — MS

**Mallory, V. Standish.** *See* Barksdale, Julian D. 07173

**Manheim, F. T.** *See* Spencer, D. W. 07631

07428 **Manspeizer, Warren.** Paleoflow structures in Late Triassic basaltic lava of the Newark Basin and their regional implication [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 142, 1969.

07429 **Margolis, Stanley V.; Kellner, Earl.** Quantitative paleoenvironmental determination of ancient sands using scanning electron microscopy and digital computer techniques [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 142-143, 1969.

07576 **Margolis, Stanley V.; Rex, Robert W.** Abrasion of sands during turbidity current transport to the deep sea, as observed by electron microscopy [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 282-283, 1969.

**Mark, Harry B., Jr.** *See* Mattson, James S. 07246

07753 **Marsal, Raúl J.; Mazari, Marcos.** El subsuelo de la ciudad de México (The subsoil of Mexico City) (2d edition): México, D.F., Univ. Nac. Autónoma México, [V. 1] text, 377 p.; [V. 2] illus., unpaged, 1969; originally published 1959.

The second edition of this contribution to the 1st Panamerican Conference on Soil Mechanics and Foundation Engineering (1959) has few modifications except to rectify errors, eliminate repetition, clarify confusing sentences, and modify an ill-founded opinion; it is presented in both Spanish and English with a glossary of terms appended. Based on some 300 borings and testing of more than 10,000 specimens, stratigraphy of the subsoil and average mechanical properties of the clayey materials were determined. Part A relates to laboratory work in stratigraphy and properties; part B to general subsidence of the city, and part C to behavior of different structures built in the Valley of Mexico. Each part is divided into chapters dealing with various aspects of soil mechanics and foundation engineering. — MCM

07117 **Marshall, Frederick C.** Lower and Middle Pennsylvanian fusulinids from the Bird Spring Formation near Mountain Springs Pass, Clark County, Nevada: Brigham Young Univ. Geology Studies, v. 16, pt. 1, p. 97-154, illus., tables, 1969.

The lower 1200 feet of the Bird Spring contain fusulinids belonging to the *Millerella*, *Profusulinella*, *Fusulinella*, and *Fusulina* Zones. Representatives of 11 genera, two new, and 11 new species and subspecies are included. Ten descriptive and informal zones, based on fusulinid distribution, are suggested for local correlation, including five subzones. Few philogenetic relations can be demonstrated, due to cyclic sedimentation. Morrowan and Derryan fauna are difficult to relate to others of the same age, but some elements are geographically widespread. The Desmoinesian portion has elements restricted to the Great Basin and Rocky Mts. on one hand, and to the midcontinent and southwest on the other. Information concerning ranges of species based on bed-by-bed analyses from local sections will form the basis for refined chronostratigraphic zonation. — *from* Author's abstract

07599 **Martin, H. L.** The Banff and Exshaw Formations in the Wabamun Lake area, Alberta (83G): Canada Geol. Survey Paper 69-7, 24 p., illus., table, 1969.

In the Wabamun Lake area the combined Banff and Exshaw Formations form a wedge which thins from more than 600 feet in the northwest to zero in the northeast owing to erosion in Late Paleozoic and post-Paleozoic times. As a result, progressively older Mississippian rocks underlie the sub-Mesozoic unconformity from west to east. The black, radioactive Exshaw shale is overlain by carbonates, shales, siltstones, and minor amounts of sandstone of the Banff Formation. The latter formation is di-

vided into three stratigraphic units which, in turn, are further subdivided into ten lithofacies that reflect their depositional environments. Oil and gas are obtained from the Middle Banff dolomitized micritic-skeletal limestone. Erosion has produced scarps of porous dolomite, and hydrocarbons are trapped at the updip edge by the overlying Lower Cretaceous shales. — Author's abstract

07430 **Martin, R. F.; Piwinskii, A. J.** Experimental study of the movement of iron in an aqueous vapor phase [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 143, 1969.

**Marvin, R. F.** *See* Barker, Fred. 00133

07431 **Marzolf, John E.; Merifield, Paul M.** Sand waves produced by tidal currents in the Gulf of California, Sonora, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 143-144, 1969.

07432 **Mathewson, Christopher C.** Origin of submarine canyons along the north shore of Molokai Island, Hawaii [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 144-145, 1969.

**Matsuo, Sadao.** *See* Smith, George I. 07495

**Matthews, R. K.** *See* Winland, H. Dale. 07547

07246 **Mattson, James S.; Mark, Harry B., Jr.; Weber, Walter J.** Direct internal reflection spectroscopic investigations of organic components in freshwater and marine sediments [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 646, 1969.

**Mattson, Peter H.** *See* Anibal, Espejo C. 00139

07433 **Maxey, George B.** Hydrogeology today [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 145, 1969.

**May, James P.** *See* Osmond, J. K. 00089

**Mazari, Marcos.** *See* Marsal, Raúl J. 07753

07061 **McBirney, Alexander R.** Andesitic and rhyolitic volcanism of orogenic belts, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 501-507, illus., tables, 1969.

Although most petrographers agree that andesites are effusive rocks of intermediate silica content, with a color index lower than 40 (percentage of dark ferromagnesian minerals), there is considerable disagreement about their compositional characteristics, chemistry, and genesis. Neither crystal fractionation nor assimilation of crustal rocks adequately explains their origin, nor does derivation from a primary andesitic magma although the great volume and uniformity of andesites erupted in a given province throughout long episodes of volcanism lend some support to the concept of a primary andesitic magma. Rhyolites are generally limited in occurrence, with the exception of ignimbrite sheets, which are widespread and characterized by extreme composition and great volume. Large-scale melting of the crust may have been responsible for their origin, but the assumption of a unique mechanism may prove to be unsatisfactory. — MS

00168 **McCammon, R. B.** An information theoretic approach to stratigraphic systems analysis [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 28, 1970.

07196 **McClellan, Guerry H.; Lehr, James R.** Crystal chemical investigation of natural apatites: Am. Mineralogist, v. 54, nos. 9-10, p. 1374-1391, illus., tables, 1969.

Studies were made of the mineralogy and composition of the apatite fractions of 110 phosphate ores that represent nearly all the economically important deposits in the world. Most of the samples represent sedimentary deposits, and their apatites are the

carbonate-substituted variety, francolite, but some igneous and metamorphic deposits were included. All the apatites showed the same correlations of crystallographic properties with chemical composition. Values of *a* ranged from 9.322 to 9.409 A, and those of *c* from 6.876 to 6.901 A; the standard error for both parameters was 0.003 A or less. Isomorphous substitution of carbonate for phosphate in the apatite structure results in a non-linear decrease of *a* with increasing substitution of $CO_3$ for $PO_4$, and calculations of unit-cell contents show that substitution of $CO_3$ for $PO_4$ is practically one for one. — Authors' abstract

07277 **McComas, Murray R.; Hinkley, Kenneth C.; Kempton, John P.** Coordinated mapping of geology and soils for land-use planning: Illinois Geol. Survey Environmental Geology Notes, no. 29, 11 p., illus., 1969.

Integrated studies of soil and geology should include field observations, sampling, and laboratory analyses from which soil and geologic maps can be developed. Interpretation is in the form of maps showing conditions relevant to a particular use. To furnish some of the background needed by planners, basic information on the nature and significance of soils and related geologic data, a description of techniques used for coordinating data, and a discussion of how the information can be adapted to land-use planning are incorporated. — ESL

07434 **McCracken, Willard A.** Environmental reconstruction — Sespe Formation, Ventura Basin, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 145-146, 1969.

**McDougall, David J.** *See* Semec, Branko. 07488

07644 **McDowell, L. L.; Stephens, J. C.; Stewart, E. H.** Radiocarbon chronology of the Florida Everglades peat: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 743-745, illus., table, 1969.

Radiocarbon measurements indicate that peat formation in the upper Everglades began about 4,400 years B.P. (before present). The average rate of peat development was about 8.4 cm/century (4400 B.P. to A.D.1914). Since drainage, initiated in the early 1900's, about one-halfof the original peat profile observed in 1914 has been destroyed. — Soil brief

07165 **McGlashan, D. W.; Rovig, A. D.; Podobnik, Donald M.** Assessment of interfacial reactions of chalcopyrite: Soc. Mining Engineers AIME Trans., v. 244, no. 4, p. 446-452, illus., 1969.

Crystal-chemical and structural properties of sulfide minerals are considered. The information gained is to be used to interpret freshly broken mineral surfaces, modifications of the mineral surfaces, and reactions at the mineral surfaces. from these basic disciplines, concepts with regard to the changes that surfaces undergo, reactions that might take place, the geometry of the interface, the state of different atoms and ions in the interface, and other physical and chemical properties of an interface must be developed, weighed and applied. The authors first deal with these conceptual considerations from which hypotheses are set forth to describe the environmental-interfacial relationships for several sulfide minerals. — Authors' abstract

07435 **McIntyre, Andrew; Jantzen, Ronald E.** North Atlantic Pleistocene climatic fluctuations deduced from coccolith floras [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 146, 1969.

00131 **McIntyre, David H.; Aaron, John M.; Tobisch, Othmar T.** Cretaceous and lower Tertiary stratigraphy in northwestern Puerto Rico: U.S. Geol. Survey Bull. 1294-D, p. D1-D16, illus., 1970.

The products of Late Cretaceous and early Tertiary submarine volcanism are separated into two contrasting suites by a major northwest-trending wrench fault. The Yauco Mudstone, and the Maricao Basalt, both units of Late Cretaceous (Campanian-Maestrichtian) age are exposed southwest of the fault. Northeast of the fault

are oxidized basalt and andesite tuff breccia of the Upper Cretaceous (Campanian-Maestrichtian) Río Blanco Formation, the plagioclase porphyry lavas and rhyodacitic vitric and pumice tuffs of the Eocene Concepción Formation, amygdaloidal basalt lavas and pyroclastic rocks of the middle Eocene Mal Paso Formation, and the andesitic and dacitic tuff breccia, coarse tuff, thin-bedded sandstone, and mudstone of the middle Eocene Río Culebrinas Formation. An unconformity may be present between the Upper Cretaceous and the Eocene rocks. – DHM

**McKee, Bates.** *See* Barksdale, Julian D. 07173

07758 **McKenzie, D. P.** The Mohorovicic discontinuity, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 660-664, illus., 1969.

Various explanations that have been proposed for the variations in crustal thickness and the sudden increase in seismic velocities at the Mohorovicic discontinuity are reviewed. Ranges of seismic velocities in ocean basins and shield areas and results of high pressure and temperature experiments give strong support to the concept of a basaltic lower crust underlain by a peridotitic upper mantle. The transition from crust to upper mantle is poorly defined, but refracted arrivals from both the continental and oceanic M-discontinuity suggest a thin transitional layer. — MS

00207 **McKnight, Edwin T.; Fischer, Richard P.** Geology and ore deposits of the Picher field, Oklahoma and Kansas: U.S. Geol. Survey Prof. Paper 588, 162 p., illus., tables, geol. map, 1970.

The Picher field, one of the great mining districts of the World, has produced (1904-1964) 7,280,000 short tons of zinc and 1,770,000 short tons of lead, valued at 1.4 billion dollars. The ores are replacement sulfide deposits in Mississippian cherty limestones that are relatively flat lying. Minor warping of the strata in the vicinity of the Miami structural trough and related features has brecciated the chert in certain incompetent strata and produced jointing along which the ore-bearing solutions were later introduced. Certain strata were more susceptible than others, which generally resulted in nearly horizontal stopes. Depending on the pattern of jointing, and partly on the stratigraphic unit, the deposits may be curvilinear (runs) or blanketlike. They are believed to be of magmatic origin, introduced through deep fractures in the granitic Precambrian basement. — ETM

07436 **McLachlan, Dan, Jr.** The slope of the melting point curve with pressure on metals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 147, 1969.

07437 **McManus, Dean A.; Burns, Robert E.** Deep sea drilling results from the northeast Pacific [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 147, 1969.

07627 **McQuivey, Raul S.; Keefer, Thomas N.** The relation of turbulence to deposition of magnetite over ripples, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D244-D247, illus., 1969.

Sorting of magnetite and other heavy minerals from predominantly quartz bed material occurs because of variations in turbulent shear stress from trough to crest of ripples and because for particles less than one-tenth millimeter in diameter critical shear stress is a function of density only. The sorted particles of heavy minerals tend to accumulate just upstream of ripple crests. It is suggested that artifically generated turbulence could be employed to sort small-sized heavy-mineral particles from sediment flows. — Authors' abstract

07063 **Mehnert, K. R.** Petrology of the Precambrian basement complex, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 513-518, 1969.

On the premise that knowledge of the Precambrian basement and its high-grade transformation processes represents a base from which conclusions can be drawn relating to processes occurring at greater depth, the general characteristics of sedi-

mentary, metamorphic, and magmatic rock types of Precambrian shields are summarized. Extrapolation of the data indicates that at an early stage the oldest crust was acid to intermediate in composition and that the oldest magmatic rocks were granitic or granodioritic to biotite quartz dioritic in composition, palingenetic in origin, and derived from a mixed volcanic-sedimentary rock series probably formed in pre-geologic time. — MS

**Melhorn, W. N.** *See* Davis, L. G. 07274

**Melhorn, Wilton N.** *See* Turner, A. Keith. 07526

**Menard, H. W.** *See* Chase, C. G. 00209

00200 **Menzer, Fred J., Jr.** Geochronologic study of granitic rocks from the Okanogan Range, north-central Washington: Geol. Soc. America Bull., v. 81, no. 2, p. 573-578, illus., tables, 1970.

Ages derived from rubidium-strontium determinations of whole rocks, biotite, muscovite, and apatite; fission-track determinations of apatite, sphene, and zircon; and lead-alpha determinations of zircons are evaluated in terms of the regional and local geological framework of the Okanogan Range, Washington and British Columbia. Late Cretaceous (81 m.y.) granodioritic-quartz monzonitic intrusions and Middle Cretaceous (104 m.y.) metamorphism of a trondhjemitic batholith are defined. The minimum age of this early regional metamorphic and intrusive event is established at 129 m.y.

07438 **Menzer, Fred J., Jr.** Experiments with a second course for superior studies students and with the summer field course [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 148, 1969.

07439 **Menzer, Fred J., Jr.; Jones, J. Allan.** Crustal evolution of the central Okanogan Range, Washington [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 148-149, 1969.

**Mercado, Jose.** *See* Howard, Arthur D. 00106

07266 **Merchant, S. R.; Rosauer, E. A.** Layering phenomena in colloidal suspensions [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 5, p. 289-299, illus., tables, 1969.

Aged suspensions of microspheres and two kaolinites exhibit several horizontal layers. Particle concentration is greater at the top of a layer; lower layer tops have increasing particle concentrations. Lower layers also settle more rapidly than upper layers; however, an increase in original suspension concentration results in a proportional increase in the particle concentration of comparable layers and causes them to settle at a slower rate. The average equivalent diameter of particles within and between kaolinitic layers and also the maximum measured diameters are identical. Microsphere layers show similar uniformity of average and maximum diameters. Ultimate settling of layers in suspension does not result in observable layers in the sediment. Data indicate that, in colloidal suspension, particles interact to become observable as definite horizontal layers. A sequence of mechanisms is proposed for layer formation. — *from* Authors' abstract

**Merifield, Paul M.** *See* Marzolf, John E. 07431

07587 **Merriam, Daniel F.** (editor). Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, 41 p., illus., tables, 1969.

Papers included in this symposium were presented at the annual meeting of the AAPG in Dallas, Texas, on April 15, 1969. Five papers and two abstracts are cited separately. — ESL

07588 **Merriam, Daniel F.** Computer utilization by geologists, *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 1-4, illus., tables, 1969.

Applications of computer-oriented techniques in earth science are numerous, many in stratigraphy, sedimentology, and paleontology. Statistical techniques were adapted easily to computers. Literature dealing with computer applications has also blossomed. Results of the data obtained from a questionnaire sent to everyone on the Computer Contribution distribution list are presented. — ESL

07440 **Merrill, Glen K.** Pottsville (Pennsylvanian) platform conodonts from Ohio [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 149, 1969.

**Merrill, Robert H.** *See* Wisecarver, David W. 07164

**Merritt, Gary L.** *See* Emrich, Grover H. 00150

**Mescherikov, Yu. A.** *See* Artyushkov, E. V. 07082

**Meszoely, Charles A. M.** *See* Estes, Richard. 07286

07682 **Metsger, Robert W.; Skinner, Brian J.; Barton, Paul B., Jr.** Structural interpretation of the Sterling Hill ore body, Ogdensburg, New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 150, 1969; Econ. Geology, v. 64, no. 7, p. 833, 1969.

07683 **Meyer, David L.** Functional morphology and living habits of shallow water unstalked crinoids of the Caribbean Sea [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 150-151, 1969.

00094 **Meyerhoff, A. A.** Continental drift — Implications of paleomagnetic studies, meteorology, physical oceanography, and climatology: Jour. Geology, v. 78, no. 1, p. 1-51, illus., 1970.

Evaluation of paleomagnetic methods and results suggests that paleomagnetic pole determinations cannot be used to show relative movement between continents. Paleoclimatic data used in support of current concepts of continental drift are incomplete or do not include the results of modern research in meteorology, physical oceanography, and climatology. Relations of reliable paleoclimate indicators suggest that planetary wind- and ocean-current circulation patterns have changed little since mid-Proterozoic time, although the width of climatic zones has changed with fluctuations in world climate. The positions of the rotational pole, ocean basins, and continents appear to have been the same for the past 800-1,000 m.y., and Atlantic and Arctic basins seem to be ancient features. The modern concepts of continental drift and polar wandering require multidiscipline re-evaluation. — ETR

07684 **Miller, Ralph L.** Pennsylvanian formations of Virginia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 151, 1969.

07725 **Miller, Reuben F.** Differences in soil chemistry induced by evaporation and flow of ground water, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D255-D259, illus., 1969.

Soil samples from a drainageway between two prairie potholes in North Dakota were analyzed to determine if and how migration of water through and upward from the saturated zone might influence chemical composition of water flowing from upper to lower pond. Water in the unsaturated zone, that apparently achieves capillary equilibrium during the night, subsequently drains back down each day when equilibrium immediately above the water table is disrupted by transpiration. Salinity of water draining back to the water table is apparently increased as a result of transpiration. The proportion of sodium to calcium and magnesium in the water draining back to the water table is increased as a result of ion exchange. These processes produce an increase in both salinity and proportion of sodium to calcium and magnesium of water arriving at the lower pond from the upper. — *from* Author's abstract

07218 **Miller, Robert C.; Moore, Samuel L.** Geologic map of the Hudgins quadrangle, Green and Hart Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-834, scale 1:24,000, text, 1969.

The known mineral resources of the Hudgins quadrangle are limestone from the Girkin Formation and Ste. Genevieve Limestone, conglomerate in the northeastern section, and minor amounts of oil and gas. — MCM

**Miller, Thomas P.** *See* Patton, William W., Jr. 00130

00169 **Miller, William H.** Tectonic and structural history of the Staten Island serpentinite [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 28-29, 1970.

07577 **Milton, Charles.** Crystallographic classification of $R^{III}OOH$ compounds [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 283-284, 1969.

07199 **Mitra, G. B.; Bhattacherjee, S.** X-ray diffraction studies on the transformation of kaolinite into metakaolin — [Pt.] 1, Variability of interlayer spacings: Am. Mineralogist, v. 54, nos. 9-10, p. 1409-1418, illus., table, 1969.

Georgia kaolinite, untreated and dehydrated at temperatures ranging between 200°-600°C, have been studied for X-ray line broadening of their basal reflections. Interlayer spacing for basal planes varies by a constant fraction of the mean value. Fractional change in interlayer distance and proportion of planes so affected have been evaluated by Mitra's (1963) method for all stages of dehydration except the last two when only one reflection is available. A single line technique developed for this purpose, was used for all stages. Disorder originally present in the untreated sample, as variability of interlayer spacings, is increased only at earlier stages. At the next stage, extent of disorder remains the same but more planes are affected. Finally, disorder increases leading to collapse of the kaolin layer and formation of metakaolin. Two types of crystallites exist, one more prone to disorder than the other. — *from* Authors' abstract

07685 **Mitterer, Richard M.** Role of organic matter in the formation of biogenic and "inorganic" carbonates [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 151-152, 1969.

07096 **Miyamura, Setumi.** Seismicity of the Earth, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 115-124, illus., tables, 1969.

Four depth ranges are proposed as the basis for classification of earthquakes. In addition to the shallow and intermediate earthquakes of the generally accepted threefold grouping of earthquakes, transient and deep groups are distinguished in the traditional deep-focus earthquake category. Tabulated data on magnitude, frequency and energy relations for 30-km intervals, at 33 km, and for the four depth groups are presented. — MS

07050 **Miyashiro, Akiho.** Metamorphism and its relation to depth, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 519-522, illus., table, 1969.

Regional metamorphism takes place at various depths in the crust and can be considered a continent-forming process. Mineral assemblages diagnostic of temperature and pressure conditions, stability relations of anhydrous minerals, and other parameters for identification of high and low pressure-temperature types of regional metamorphism are discussed, and the possible role of energy and materials from the mantle is noted. — MS

07686 **Moench, Robert H.** Premetamorphic down-to-basin faulting and folding in the Rangeley area, western Maine [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 152, 1969.

07333 **Mohsen, Lotfi Abdel-Fattah M.** Distribution of manganese in the Philipsburg batholith, Montana and its relationship to associated manganese ore deposits [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2254B, 1969.

07334 **Moiola, Richard James.** Late Cenozoic geology of the northern Silver Peak region, Esmeralda County, Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2254B, 1969.

07250 **Monroe, John N.** Remote sensing of ore deposits by fluorescence [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 652, 1969.

07687 **Moody, D. W.; Kays, Olaf.** Application of the Generalized Information Processing System (GIPSY) to the storage and retrieval of earth sciences literature [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 152-153, 1969.

00170 **Moore, Bruce R.** Age dating and sedimentation rates in Recent Ohio River sediments, Kentucky, implied by the distribution of Pennsylvanian age coal particles [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 29, 1970.

07214 **Moore, Carl A.** Geologic factors which may affect the occurrence of natural gas in the Oklahoma Panhandle: Shale Shaker, v. 20, no. 3, p. 49-55, illus., 1969.

Regional geology for each of the three counties in the Panhandle is described. Beaver County, on the hinge line between shelf and steep basin flank, contains large numbers of multiple stratigraphic traps. The lower Morrow is a uniform blanket-type sand body that may thin over topographic highs; upper Morrow sandstones are diverse, at least four separate bodies and a channel sand. Channel sands are sensitive to sea-level fluctuation and may be connected by fingers and overlain by blanket sands. Four factors in the variation of gas analyses are related to depth of production; nitrogen and helium content is high above 5,000 feet. Sources of helium are discussed; most appears to have been generated from Morrow sands which are now the reservoir rocks. These sands may include fragments of igneous rocks containing uranium and thorium. The helium trapping mechanism is discussed. — ESL

07688 **Moore, Clyde H., Jr.; Boutte, Andre L.** Cretaceous carbonate sand-spit, tidal channel sequence — A recent-ancient analogue [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 153, 1969.

07578 **Moore, D. M.; Lahann, Richard W.** Preliminary report on a sample of the Purington Shale prepared as a gechemical standard [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 284, 1969.

07689 **Moore, John M., Jr.** Metamorphism in Thor-Odin gneiss dome, British Columbia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 154, 1969.

07738 **Moore, Raymond C.; Strimple, Harrell L.** Explosive evolutionary differentiation of unique group of Mississippian-Pennsylvanian camerate crinoids (Acrocrinidae): Kansas Univ. Paleont. Contr. — Paper 39, 44 p., illus., 1969.

Crinoids of the family Acrocrinidae are distinguished from all other Camerata in having circlets of supplemental calyx plates called intercalaries, 6 to > 600 in number, between the bipartite basals and the ring of radials and primanal at the calyx summit. Two subfamilies and 9 new genera are here differentiated from *Acrocrinus*, formerly sole genus of the family; of the 13 already described species, 11 are assigned to the new genera, and 7 new species are assigned to *Planacrocrinus*, *Globacrocrinus*, *Caucacrocrinus*. Remarkable evolutionary changes along different lines are expressed, especially by explosively rapid increase in number of intercalaries to a Late Mississippian peak, followed by reversion to relatively simple structure. Two species occur in Europe, the others in central United States. — VMJ

**Moore, Samuel L.** *See* Miller, Robert C. 07218

07729 **Morris, Robert C.** Flysch sub-facies in Stanley—Jackfork rocks, Ouachita Mountains, Arkansas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 154, 1969.

**Mortland, M. M.** *See* Doner, H. E. 07264

07600 **Mott, R. J.** Palynological studies in central Saskatchewan — Contemporary pollen spectra from surface samples: Canada Geol. Survey Paper 69-32, 13 p., illus., tables, 1969.

Saskatchewan lies within two vegetational zones: grasslands or prairie, and boreal forest. Surface samples collected for a study of late-glacial and postglacial geochronology and vegetational and climatic history yielded contemporary pollen spectra characteristic of both zones. Pollen spectra typical of the grasslands contained 60-70 percent herbs, 25-35 percent trees, and 5 percent or less shrubs. Spectra from forested areas showed varying amounts of tree pollen, typically in excess of 50 percent, with herb pollen usually less than 35 percent. Although not so readily distinguishable by their pollen spectra [as in grasslands], some sections of the boreal forest were found to have discernible pollen assemblages. In addition to general relative proportions of tree, shrub, and herb pollen, data on abundance of individual genera are needed to differentiate forest sections. — *from* Author's abstract

07601 **Mott, R. J.; Camfield, M.** Palynological studies in the Ottawa area: Canada Geol. Survey Paper 69-38, 16 p., illus., 1969.

One large bog and five buried bog deposits were sampled in the Ottawa area [Ontario]. Radiocarbon dates, obtained near the base of four of these sections, ranged from about 7,650 yr B.P. to roughly 8,830 yr. B.P. Pollen analysis of samples from the six sites revealed four zones, Terasmae's zone IV being the oldest. At only two of the sites were all four zones present; at the others, all or part of some zone was missing. — Authors' abstract

**Mower, R. W.** *See* Handy, A. H. 07626

00103 **Mudge, Melville R.** Origin of the disturbed belt in northwestern Montana: Geol. Soc. America Bull., v. 81, no. 2, p. 377-392, illus, tables, geol. map, 1970.

A complex of westward dipping thrust faults, related folds, and normal faults in northwestern Montana involve a thick geosynclinal sequence of sedimentary rocks of the Belt Supergroup of Precambrian age and overlying miogeosynclinal rocks of Paleozoic and Mesozoic age. The thrust faults and folds are probably the result of décollement sliding off the eastern side of a large epeirogenic uplift under the influence of gravity, facilitated by abnormal fluid pressure. The décollement masses moved eastward across and deformed the rocks of a small Mesozoic basin which had developed at the eastern side of the earlier geosyncline. Normal faults developed after thrusting; some probably involve the basement, and some, such as those along the Rocky Mountain trench, are probably pull-away faults at the rear of décollement plates. Similar structures, which may be due to the same processes, extend northwestward in Canada.—WHN

07690 **Mueller, George.** Hydrothermally differentiated carbonaceous complexes from the Illinois-Kentucky fluorspar district [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 154-155, 1969.

07745 **Mueller, Robert F.; Olsen, Edward J.** Mineral assemblages and the chemical history of chondritic meteorites: Fieldiana — Geology, v. 16, no. 15, p. 377-410, illus., table, 1969.

The thermodynamic basis for observed mineral assemblages of ordinary chondrites is discussed with respect to temperature of crystallization, state of oxidation, and liquidus relations. The field of oxidation of ordinary chondrites is quite well defined; they are more oxidized than solar gas so could not have condensed from it. Chondrites of uniform composition probably represent rapid crystallization through

liquidus temperatures. Nonuniform, disequilibrium chondrites appear to represent a lower rate of cooling and crystalization and originated under conditions of varying oxidation. Analytical relations are derived relating normative olivine contents of chondrites to the degree of oxidation; there is a good correspondence between this derived relation and that observed for 43 chondrites. A critique is also presented of certain views on the origin of chondrites which depend primarily on mineral chemistry. — *from* Author's abstract

**Muffler, L. J. Patrick.** *See* Brew, David A. 07603

**Munson, Elaine L.** *See* Young, E. J. 07724

**Muratov, M. V.** *See* Khain, V. E. 07051

**Murphy, Vincent J.** *See* Holt, Richard J. 07373

07691 **Murtaugh, John G.** Contact metamorphism as evidence of impact origin of igneous rocks in the Manicouagan cryptoexplosion structure, Quebec [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 155, 1969.

**Mutschler, Felix E.** *See* Lipman, Peter W. 07606

**Myer, George H.** *See* Williamson, Terrance C. 07545

**Myers, A. T.** *See* Young, E. J. 07724

07692 **Naeser, C. W.; Stuart-Alexander, Desiree E.** The age and temperature of the Mule Ear diatreme, southeastern Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 155-156, 1969.

07083 **Nagata, Takesi.** Reduction of geomagnetic data and interpretation of anomalies, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 391-398, illus., 1969.

Magnetic fields caused by secondary magnetization of geologic bodies complicate the distribution pattern of the Earth's magnetic field. The parameters involved in equations for interpretation of the general field distribution and anomaly patterns are defined. The magnetic properties of rocks generally consist of induced magnetization, represented by the magnetic susceptibility associated with the volume percentage content of magnetic minerals, and natural remanent magnetization, whose intensity and direction vary depending on the geologic history and petrography of the particular rocks. — MS

07693 **Nagy, Bartholomew.** Studies of carbonaceous meteorites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 156, 1969.

07658 **Nakano, Yoshisuke.** Stability of difference approximation to shock wave propagation in inhomogeneous elastic-plastic media: U.S. Army Corps Engineers Cold Regions Research and Eng. Lab. Research Rept. 277, 9 p., 1969.

An analysis is made of the stability of difference approximation to one-dimensional shock wave propagation in elastic-plastic media. The stability of the artificial dissipation method for inhomogeneous elastic-plastic media is discussed in order to obtain a stable computational scheme for the problem. The study of shock wave propagation through solid media is necessary for the understanding of explosion phenomena. — MCM

07694 **Naldrett, A. J.; Gasparrini, E. L.; Rucklidge, J. C.; Bray, J. G.; Podolsky, T.** Cryptic variation and the petrology of the Sudbury nickel irruptive [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 156-157, 1969; Econ. Geology, v. 64, no. 7, p. 833, 1969.

07695 **Nash, William P.; Wilkinson, J. F. G.** Crystallization of mafic minerals in the Shonkin Sag laccolith, Montana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 157-158, 1969.

07598 **Nassichuk, W. W.; Christie, R. L.** Upper Paleozoic and Mesozoic stratigraphy in the Yelverton Pass region, Ellesmere Island, District of Franklin: Canada Geol. Survey Paper 68-31, 31 p., illus., geol. map, 1969.

Upper Paleozoic and Mesozoic formations in the Tanquary Fiord-Yelverton Pass area of the Sverdrup Basin include rocks of both marginal and basinal facies with a maximum thickness of about 11,000 feet. Formational thicknesses are variable, particularly near the basin margin, and all formations are separated by disconformities. The entire upper Paleozoic-Mesozoic sequence is structurally conformable internally. A late Paleozoic-early Mesozoic structural high, the Tanquary structural high, lying between Yelverton Pass and the head of Tanquary Fiord, is named. Upper Triassic beds rest unconformably on lower Paleozoic basement rocks over most of this feature, whereas, adjacent to the high, the basement rocks are unconformably overlain by upper Paleozoic rocks. — Authors' abstract

07696 **Neathery, Thornton L.; Drahovzal, James A.; Raymond, Dorothy E.** The Upper Ordovician of Alabama [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 158, 1969.

07592 **Neidell, Norman S.** Ambiguity functions and the concept of geological correlation, *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 19-33, illus., 1969.

Principles and theory requisite for calculating ambiguity and similarity functions are presented and discussed. Basically, these are generalizations of the cross-correlation (or cross-covariance) function where a scale stretch (or shrink) parameter has been introduced. The similarity function employs a range-limiting parameter to allow for inconsistent trends. Use of these functions makes it possible to attach a quantitative meaning to the geological notion of correlation. The inconsistency between the mathematical-statistical definition of correlation and the more general intuitive meaning of the same word is eliminated. Synthetic and real calculations are discussed to illustrate the method. Several of the key subroutines used in the computing are also listed and explained. — *from* Author's summary

07697 **Nelson, C. Hans.; Hopkins, David M.; Ness, Gordon.** Interpreting complex relict and modern sediment patterns of the Bering shelf [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 159, 1969.

**Nelson, L. A.** *See* Steele, Forrest. 07727

07698 **Nelson, Robert S.; Semken, Holmes A.** Paleoecological and stratigraphic significance of the muskrat in Pleistocene deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 159-160, 1969.

**Nelson, Willis H.** *See* Pierce, William G. 00097

**Ness, Gordon.** *See* Nelson, C. Hans. 07697

**Nesteroff, W. D.** *See* Charm, W. B. 07157

**Neuman, Shlomo P.** *See* Witherspoon, P. A. 07553

07699 **Nichols, Maynard M.** Aspects of coastal oceanography from space photography [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 160, 1969.

07700 **Nichols, Robert L.** Identification of hot and cold deserts in the stratigraphic record [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 160-161, 1969.

07701 **Nichols, William D.** Geohydrologic evaluation of the Englishtown Formation by digital computer [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 161-162, 1969.

07730 **Nickel, Ernest H.; Gillieson, Archibald H.; Ripley, Leonard G.** Microhardness, infrared absorption and bond energies of $FeS_2$, $CoS_2$ and $NiS_2$ [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 162, 1969.

**Nisbet, Jerry J.** *See* Judd, Robert W. 07151

07702 **Nordeng, Stephan C.; Babcock, Larry L.** A re-examination of the middle Keweenawan of the Keweenaw Peninsula, Michigan [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 162, 1969.

00204 **Nordstrom, Charles E.** Lusardi Formation — A post-batholithic Cretaceous conglomerate north of San Diego, California: Geol. Soc. America Bull., v. 81, no. 2, p. 601-605, illus., 1970.

The Lusardi Formation, discontinuously exposed near Rancho Santa Fe, California, unconformably overlies Late Jurassic to Early Cretaceous igneous and metamorphic rocks and is unconformably overlain by Eocene La Jolla Formation. The Lusardi Formation is a red brown coarse conglomerate with clasts up to 30 feet in diameter derived from underlying rocks. Conglomerate is massive except for thin lenses of arkose. Terrestial deposition in an alluvial fan environment is indicated. — *from* Author's abstract

07703 **Normark, W. R.; Allison, E. C.; Curray, J. R.** The geology of the Pacific continental margin of the Peninsula of Baja California, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 163, 1969.

07233 **Novitzki, R. P.; VanVoast, W. A.; Jerabek, L. A.** Water resources of the Yellow Medicine River watershed, southwestern Minnesota: U.S. Geol. Survey Hydrol. Inv. Atlas HA-320, 3 sheets, scale 1:250,000, text, 1969.

Sheet 1 contains information on the water budget, block diagrams, and tabulated summaries of aquifers and recreational aspects of water resources in the Yellow Medicine River watershed; sheet 2 refers to ground water and sheet 3 to surface water. Glacial drift and Cretaceous sedimentary rocks are the major aquifers. Yield available from ground-water sources is adequate to supply present demands, and further development is possible. About 75 percent of water used is obtained from ground-water sources. Water is generally very hard with high concentrations of dissolved solids; that obtained from sandstone aquifers (sodium chloride type) is usually softer. Most water supplies have been found at depths of less than 200 feet. — MCM

07704 **Nowacki, W.; Edenharter, A.; Engel, P.; Ohmasa, M.; Ribar, B.; Takeuchi, Y.** On sulfosalts [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 163-164, 1969.

00216 **Oakeshott, Gordon B.** Geology of the California Coast Ranges: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 1, p. 7-10, illus., 1970.

The Coast Ranges province includes a series of north-northwest trending ranges and intermontane valleys. Each range has a somewhat independent history, linked by major episodes into a distinctive province. Precambrian history is unknown, and no rocks of Paleozoic or Triassic age have been recognized, but great thicknesses of Jurassic-Holocene sedimentary and igneous rocks reveal a complex history. Late Jurassic and Cretaceous orogeny and granitic intrusions affected the region, and local crustal disturbances occurred throughout the Tertiary, culminating in the Pliocene-Pleistocene Coast Range orogeny. Tertiary formations are principal source and reservoir rocks for oil and gas. Three great north-northwest-trending fault zones, the Nacimiento-Sur zone, the San Andreas, and the South Fork Mtn. fault, dominate the structure. Elongate masses of peridotite and serpentine are important in the structural picture. — ESL

00171 **O'Donnell, Edward.** The petrology of the Brassfield Formation (Lower Silurian) in the Cincinnati arch area [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 29-30, 1970.

07057 **O'Hara, M. J.** Phase equilibrium studies relevant to upper mantle petrology, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 634-637, 1969.

Results of recent investigations of polymorphism and melting relationships in simple phases, changes of subsolidus phase assemblages, and liquidus relations are applied to interpretation of the composition of the mantle. The stable ultrabasic rocks are defined as peridotites composed of magnesian olivines, clino- and orthopyroxenes, and an alumina-rich phase represented by plagioclase, spinel, and garnet at low, intermediate, and high pressures respectively. With high temperatures, under intermediate to high pressures, the alumina-rich phase is reduced, and in some cases eliminated. Eclogite is the high-pressure equivalent of basaltic or gabbroic compositions. Extrusive basaltic magmas are not primary, but are products of fractionation and reaction with wall rock. — MS

**Ohmasa, M.** *See* Nowacki, W. 07704

07705 **Ohmoto, Hiroshi; Borcsik, Maria; Holland, Heinrich D.** Chemistry and origin of hydrothermal fluids at the Bluebell mine, British Columbia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 165, 1969.

07706 **Oldale, R. N.; Uchupi, Elazar.** Geologic history on the glaciated shelf off northeastern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 165-166, 1969.

07622 **Olevson, K. L. R.** Energy balances for transient water craters, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D189-D194, illus., tables, 1969.

Studies of transient craters in water, produced by falling water drops, show that significant amounts of energy are present as kinetic energy in a cylindrical wave which surrounds the crater when the crater has reached its maximum size. At maximum size, about 80 to 90 percent of the initial drop kinetic energy can be accounted for as potential energy, surface energy, and kinetic energy of the outwardly expanding cylindrical wave. The energy partitioning changes with velocity and crater size. For 14-milligram drops with velocities near 155 centimeters per second, surface energy is the most important energy sink, whereas potential energy is the most important energy sink at velocities near 566 centimeters per second. The percentage of kinetic energy in the cylindrical wave increases with increasing drop velocity and may exceed the percentage of surface energy for the highest velocities. — Author's abstract

**Olinger, Bart.** *See* Jamieson, John C. 07749

**Oliphant, J. D.** *See* Cheney, E. S. 00145

**Olsen, Edward J.** *See* Mueller, Robert F. 07745

00172 **Olsson, Richard K.; Gaffney, Eugene S.** The Cretaceous-Tertiary datum in New Jersey [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 30, 1970.

07707 **Olsson, Richard K.** Planktonic foraminiferal biostratigraphy of Leg V, Deep Sea Drilling Project — Northeastern Pacific [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 166, 1969.

07584 **Ondrick, Charles W.; Griffiths, John C.** FORTRAN IV computer program for fitting observed count data to discrete distribution models of binomial, Poisson and negative binomial: Kansas Geol. Survey Computer Contr. 35, 20 p., illus., 1969.

The program fits observed count data to Poisson, positive binomial, and negative binomial discrete distribution models. The observed distribution is compared to the

theoretical by the method of Chi square. The fit of observed distribution of sphene and epidote in the Rensselaer Graywacke, New York, and of quartz in the Cow Run Sandstone, are used as examples. A simulated grid sampling of Kansas for oil and gas occurrences yields a negative binomial distribution. — ESL

07708 **Onyeagocha, A. C.; Seifert, K. E.** Optical characteristics of Adirondack anorthosite plagioclase [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 166-167, 1969.

00173 **Oostdam, B. L.; Swift, Robert N.** Variations in tidal currents, salinity and turbidity across the Delaware Bay mouth [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 30-31, 1970.

07709 **Opdyke, Neil D.** The paleomagnetic correlation of marine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 167, 1969.

07710 **Orgel, Leslie E.** Planetary organic analyses and prebiotic chemistry [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 167, 1969.

07227 **Orgren, James R.** Earth science — Then and now: Jour. Geol. Education, v. 17, no. 5, p. 179-183, illus., table, 1969.

Antecedents of modern earth science, namely geology, astronomy, and physical geography, were in the secondary curriculum of the nineteenth century, but had disappeared from the high school curriculum by the time of the Great Depression. Geology and astronomy decreased as physics increased; physical geography fell when general science became popular. Causes offered for the decline of earth science include: descriptive, nonlaboratory nature of courses, dependence by teachers on rote memorization methods, and at the root, inadequate teacher preparation. Earth science today, with a boost from the Earth Science Curriculum Project, is making rapid gains in the secondary curriculum. Failure by colleges to institute programs for preparation of earth science teachers could lead to another fall in secondary earth science. — *from* Author's abstract

07711 **Oro, J.; Gelpi, E.** A discussion of the interpretation of organic analytical data — Biogenic or non-biogenic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 167-168, 1969.

07144 **Orr, R. William.** Stratigraphy and correlation of Middle Devonian strata in the Logansport Sag, north-central Indiana: Indiana Acad. Sci. Proc. 1968, v. 78, p. 333-341, illus., 1969.

The name Traverse Formation of northern Indiana and the Michigan Basin is extended into the Logansport Sag to include approximately 25 feet of strata previously separated into Miami Bend Formation, Logansport Limestone, and Little Rock Creek Limestone. Traverse rocks of the Sag and those of the Michigan Basin of equivalent late Middle Devonian age display similar lithologies, have similar depositional histories, and contain nearly identical conodont faunas. The Traverse rocks of the Sag lie within two Middle Devonian conodont zones high in the Givetian Stage and correlate with strata in New York ranging from the Levanna Shale Member of the Skaneateles Shale (Hamilton Group) through the Tully Formation. The lower zone comprises the body of strata containing *Icriodus latericrescens latericrescens* below the lowest position of *Polygnathus varcus*; the upper zone is the *P. varcus* Zone. — Author's abstract

07184 **Osborn, E. F.** Genetic significance of V and Ni content of andesites — Comments on a paper by Taylor, Kaye, White, Duncan and Ewart [1969]: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1553-1554, 1969.

The inference of Taylor and others (ibid., v. 33, no. 9, p. 1013-1014, 1969) that andesite cannot have formed by fractional crystallization of high Al-basalt is based on a method of calculation which is questioned. When the calculation relative to vanadium content is made assuming a reasonable fraction of residual andesite liquid, it seems feasible to derive andesite from high Al-basalt. — Author's abstract

00089 **Osmond, J. K.; May, James P.; Tanner, W. F.** Age of the Cape Kennedy barrier-and-lagoon complex: Jour. Geophys. Research, v. 75, no. 2, p. 469-479, illus., tables, 1970.

Thorium and uranium isotopic analyses of both modern and fossil shells and beach rock of the Cape Kennedy, Florida, area suggest that the materials can be treated as closed, datable systems that have experienced a brief open period after deposition (but before burial) during which both uranium and thorium were incorporated. An isochron method of correction for addition of Th-220 is applied, based on results from the modern materials. Two periods of deposition before the present are indicated: one at about 110 thousand years ago, and another, less extensive, at about 30 thousand years ago. These deposits appear to represent the only high sea-level stands of the Pleistocene in the area. — Authors' abstract

**Osmond, J. K.** *See* Kaufman, M. I. 07126

07065 **Ostenso, Ned A.** Magnetic anomalies and crustal structure, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 457-463, illus., 1969.

Crustal rifting in oceanic and continental areas, regional basement block structures in the USSR, and the crustal and upper mantle provinces of the United States are among the structural features that have been recognized during regional and transcontinental magnetic surveys. Advances in instrumentation and data analysis have contributed extensively to definition of such features, and further systematic research will greatly facilitate interpretations. — MS

**Overbey, William K., Jr.** *See* Wing, Richard S. 07546

**Page, Norman J.** *See* Leonard, B. F. 07191

07713 **Palmquist, Robert C.** "... In a valley proportionate to its size ..." (Hutton) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 168-169, 1969.

00092 **Pamenter, Bev.** No surprises in Sable well report: Oilweek, v. 20, no. 47, p. 7-8, 10, illus., table, 1970.

The 15,106-ft well drilled on Sable Island off Nova Scotia showed only a few traces of gas and a trace of oil; it penetrated 980 feet of Quaternary, over 3,000 of Tertiary, and over 11,000 of Cretaceous, bottoming in the Lower Cretaceous. Lithology was uniform, interbedded sandstone and shale, with minor amounts of carbonate. A log accompanies the report. Material from the core is available for examination at several locations. — ESL

07350 **Pan, Poh-Hsi.** Direct location of oil and gas by the seismic reflection method [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2262B, 1969.

**Pannella, Giorgio.** *See* MacClintock, Copeland. 07425

07714 **Parizek, Richard R.; Drew, Lawrence J.; Bauer, John W.** Factors influencing streamflow variability of rivers draining folded carbonate terranes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 169, 1969.

07715 **Park, Richard A.; Wilkinson, John W.** Systems analysis — Multidisciplinary ecosystem model [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 170, 1969.

07748 **Park, Robert G.; Lewis, Glenn C.** Electrophoretic separattion and fractionation of clay mixtures: Am. Mineralogist, v. 54, nos. 9-10, p. 1473-1476, illus., 1969.

An electrophoretic continuous particle separator makes it possible to separate mixtures of bentonite-illite and bentonite-kaolinite clays. Separating bentonite and kaolinite from an artificial mixture requires an electrolyte of 0.001 M $Na_2CO_3$ adjusted to a pH of 4.5 with HCl. The concentration of clay in suspension was 0.2

mg/ml. The suspension contained $20\times10^{-5}$ meq of $Th^{4+}$ per ml. Separating bentonite and illite from an artificial mixture required the same conditions except that the clay suspension contained $30\times10^{-5}$ meq of $Th^{4+}$ per ml. — Authors' abstract

00107 **Parks, James M.** Computerized trigonometric method for rotation of structurally tilted sedimentary directional features: Geol. Soc. America Bull., v. 81, no. 2, p. 537-540, illus., 1970.

As a substitute for the slow, error-prone stereonet methods used to establish depositional attitudes of crossbeds, a FORTRAN IV computer program has been written for a trigonometric solution. With known pole positions of the planes of the horizontal, the normal bedding, and the crossbedding forming a spherical triangle, in which two sides and enclosed angle are known, trigonometric functions are used to solve for the remaining side (amount of original dip) and one of the remaining angles (from which azimuth of rotated dip direction can be determined). Commonly two assumptions are made: (1) the original bedding plane was near horizontal, and (2) the axis of rotation during deformation was the strike of the normal beds.

07590 **Parks, James M.** Multivariate facies maps, *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 6-12, illus., tables, 1969.

Patterns of depositional environments and diagenetic changes shown on facies maps may be clues to potentially productive reservoir rocks. A single facies map that uses all available data should be the most useful. Several types of facies maps have been developed based on multivariate classification techniques. The one developed here is based on the simple distance function, which is capable of handling mixed-mode data. In cluster analysis each cluster represents a facies which can be plotted. Several multivariate facies methods using published data on carbonate studies by Purdy on the Bahama Platform around Andros Island are described and maps presented. Data on 236 sample logs of the Lower Kibbey Limestone, eastern Montana, were used in different approaches, one of which showed four facies. — ESL

07335 **Parsons, Myles Lyle.** Groundwater movement and subsurface temperatures in a glacial complex, Cochrane District, Ontario [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2255B, 1969.

07675 **Pasquera, R.; De Pablo, L.; Carbonell, M.** Kaolin deposits of Mexico, *in* Internat. Geol. Cong., Prague, 1968, Symposium 1, Proc., Kaolin deposits of the world — Oversea countries: Prague, Academia, p. 105-110, illus., tables, 1969.

The largest part of the Mexican kaolin deposits are of the primary type which originated by hydrothermal alteration of Tertiary rhyolitic rocks. The genesis includes (1) hydrothermal alteration of Tertiary rhyolites and rhyolitic tuffs, (2) weathering of rhyolitic tuffs, and (3) sedimentary deposits. Exploitation is usually effected in open pits. Reserves in the country are estimated at more than 500,000,000 tons. Kaolins are found in almost every state of the country, the main producing area being indicated in a table and schematic map. The mineralogy of the Mexican kaolin deposits are discussed as well as the methods of exploitation and mining. — GV

07190 **Patel, A. R.; Patel, M. M.** Studies on the dodecahedral faces of diamond: Am. Mineralogist, v. 54, nos. 9-10, p. 1324-1329, illus., 1969.

The dodecahedral faces of diamond have been examined by optical and electron microscopy. The electron micrographs have revealed alternately bright and dark bands formed due to the shadow of the ruts and ridges. Triangular depressions have been observed in the region of these bands and it is noted that the triangular depressions in the bright bands are oriented opposite similar features in the dark bands. It is conjectured that the bright and dark bands represent (111) and (111) planes. The intersections of these planes make the ridges and ruts associated with the striations observed on the dodecahedral faces of diamond. The implications are discussed. — Authors' abstract

**Patel, M. M.** *See* Patel, A. R. 07190

07248 **Patterson, Clair C.** Lead in the marine environment [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 647, 1969.

07112 **Patton, John B.; Dawson, T. A.** Some petroleum prospects of the Cincinnati Arch province, *in* Kentucky Oil and Gas Assoc., 33d Ann. Mtg., 1969, Proc. Tech. Sess.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 18, p. 32-39, illus., 1969.

Cambrian and Lower Ordovician rocks which offer greatest potential for major petroleum discoveries have not been tested to permit either economic appraisal or effective subsurface exploration by conventional methods. Knox Dolomite and older units contain permeable strata of dolomite and sandstone regionally truncated and overlain unconformably by Champlainian rocks that are impermeable in eastern Indiana, and large areas of Ohio and Kentucky, causing favorable conditions for stratigraphic traps. Sandstone beds of uncertain correlation but known to be Knox and older offer possibilities through both pre-St. Peter truncation and standline pinchouts. The most promising approach to exploration is probably seismic research to determine whether the major erosion surface and sandstone-dolomite interfacies can be identified. — *from* Authors' abstract

00130 **Patton, William W., Jr.; Miller, Thomas P.** Preliminary geologic investigations in the Kanuti River region, Alaska: U.S. Geol. Survey Bull. 1312-J, p. J1-J10, illus., 1970.

Reconnaissance geologic mapping and geochemical studies in the Kanuti River region indicate three areas worthy of further mineral investigation. Six large previously unreported ultramafic bodies have been mapped in a 65-mi long belt; although no mineral occurrences of economic significance were noted, additional investigation is warrented for asbestos, platinum, chromium, and nickel. Anomalous amounts of tin were found in stream sediment and pan concentrate samples from a tributary of Kanuti Kilolitna Creek; presence of placer tin deposits suggests several areas favorable for tin occurrence. Disseminated galena and sphlarite were found in a small rhyolite body; striking similarity to a lead-silver-zinc deposit reported in a rhyolite body on the Indian River suggests such bodies may be favorable targets for exploration in the area. — *from* Authors' abstract

07615 **Patton, William W., Jr.; Dutro, J. Thomas, Jr.** Preliminary report on the Paleozoic and Mesozoic sedimentary sequence on St. Lawrence Island, Alaska, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D138-D143, illus., 1969.

Preliminary investigations on eastern St. Lawrence Island indicate the presence of a heretofore unreported sedimentary sequence possibly 8,000 feet thick. Oldest strata, a thick sequence of Devonian dolomite and dolomitic limestone exposed along Seknak River, on Ongoveyuk River appear to be succeeded disconformably by at least 1,000 feet of Upper Mississippian limestone and cherty limestone, in turn overlain disconformably by a 400-ft shaly sequence Middle and Late Triassic in the upper part and probably Early Triassic or Permian in the lower. Youngest sedimentary rocks appear to be a thick section of graywacke and mudstone along Ongoveyuk River, tentatively Jurassic or Cretaceous. The Paleozoic and Mesozoic sequence shows strong lithologic and faunal similarities to coeval rocks in the Brooks Range; some counterparts appear also to be present on Seward and Chukotsky Peninsulas. — *from* Authors' abstract

07716 **Pauling, Linus.** The structure of the sulfide minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 170, 1969.

07219 **Peck, John H.** Geologic map of the Flemingsburg quadrangle, Fleming and Mason Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-837, scale 1:24,000, text, 1969.

Economic resources of the Flemingsburg quadrangle are limestone from the Grant Lake Limestone, dolomite from the Brassfield Formation, sandstone from the Farmers Member of the Borden Formation, and clay from the upper part of the Crab Orchard Formation. — MCM

07717 **Pecora, W. T.** The great leap forward [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 170-171, 1969.

07441 **Perhac, Ralph M.; Amburgey, John W., Jr.** Metal content of stream particulates and its relation to hydrogeochemical prospecting in east Tennessee [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 172, 1969; Econ. Geology, v. 64, no. 7, p. 832, 1969.

07442 **Perkins, R. D.; Halsey, S. D.** Organic erosion of Carolina shelf sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, p. 172-173, 1969.

07443 **Perry, Eugene C.; Hall, Minard L.** Oxygen isotope relations in progressively metamorphosed rocks adjacent to the Bethlehem Granite Gneiss, Mascoma quadrangle, New Hampshire [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 173, 1969.

**Peterman, Z. E.** *See* Barker, Fred. 00133

**Petersen, Ulrich.** *See* Sawkins, Frederick J. 07479

**Peterson, Etta.** *See* Kvenvolden, Keith A. 07413

**Peterson, J. B.** *See* Hiss, W. L. 07141

07635 **Peterson, J. B.; Hiss, W. L.; Garza, S.; Trantolo, A. P.; Brock, R. O.** Simulation of the Permian Capitan Limestone aquifer, southeastern New Mexico and western Texas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 174, 1969.

07445 **Peterson, M. N. A.** Present status of the JOIDES drilling — The Deep Sea Drilling Project [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 174-175, 1969.

07336 **Petocz, Ronald George.** Biostratigraphy and Lower Permian Fusulinidae of the upper Delta River area, east central Alaska Range [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2255B, 1969.

07075 **Petrushevsky, B. A.** Earthquakes and tectonics, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 279-282, illus., 1969.

Shallow earthquakes exhibit a certain relationship with surface structures, but whether this relationship reflects an effect of surface dislocation or dislocation of the surficial part of a deep structure is not always known. Earthquakes whose foci are located at greater depth generally show no direct relationship with surface structures. Large structural complexes are the product of abyssal tectonic processes, whereas earthquakes are secondary products resulting from fracturing of these structures. Four groups of regional structures are defined — young folded regions, young platforms, recently deformed platforms of any age, and continental rift zones — with reference to conditions favoring seismicity. — MS

07446 **Pevear, D. R.** Distribution of clays by currents on the shelf, slope and rise of the southeastern United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 175, 1969.

07192 **Phair, George.** The American Mineralogist — Its first four years: Am. Mineralogist, v. 54, nos. 9-10, p. 1233-1243, 1969.

The American Mineralogist, the adopted vehicle of the Mineralogical Society of America, was three years old when the Society was organized in 1919. It is this pre-MSA period in its life that is described here. A great deal of biographical material on the men prominent in launching the publication and keeping it alive, is given. The American Mineralogist was an outgrowth of the Mineral Collector which had been published from 1894-1909. In 1917, Dr. Kunz conceived the idea of a volume honoring R. J. Hauy, and when the Mineralogist published it in 1918, it really came of age. — ESL

07193 **Phair, George.** The founding of the Mineralogical Society of America: Am. Mineralogist, v. 54, nos. 9-10, p. 1244-1255, 1969.

The birth and early years of the Mineralogical Society of America have been summarized in two papers by Dean E. H. Kraus (1921, 1930). The present paper documents these two brief accounts and attempts to explore some of the problems and underlying differences of opinion out of which the Society grew; it is hoped that it will lead to fuller appreciation of the vital role played by Dean Kraus. The stimulus for formation of a mineralogical society was the dissatisfaction of mineralogists with GSA programs, and the lack of a publication outlet for mineralogical papers. The organizational meeting was held Dec. 30, 1919, and in Dec. 1920 it became affiliated with GSA. The American Mineralogist was voted the official journal of the new Society, but lacked for funds until Col. Roebling, impressed by two special numbers, presented the Society with a gift of 45,000 dollars for publishing the journal. — ESL

07447 **Philbrick, Shailer S.** Horizontal configuration and the rate of erosion of Niagara Falls [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 175-176, 1969.

07208 **Philippi, George Theodor.** Essentials of the petroleum formation process are organic source material and a subsurface temperature controlled chemical reaction mechanism, *in* Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), p. 25-46, illus., table, 1969.

Oil hydrocarbons compared with hydrocarbons extracted from an upper Pliocene to upper Miocene sequence of shales indicate that the Los Angeles basin oils originated in organic-rich upper Miocene shales; experiments give proof of a mechanism by low temperature chemical reactions. In Los Angeles and Ventura basins, Calif., hydrocarbon content and hydrocarbon-noncarbonate carbon ratio increase slowly with depth and age in Pliocene shales and more rapidly in the deeper and warmer upper Miocene shales. In both basins the bulk of petroleum is generated at depths where temperature is above 115°C and shales are sterile to bacteria, which confirm thermal, nonbiological processes, strongly temperature dependent. With lesser temperature gradient in Ventura basin, a greater depth is required than in Los Angeles basin. Apparently lipids are a major source material of petroleum. — GDC

**Phillippe, W. R.** *See* Barnhisel, R. I. 07733

**Phillips, J. D.** *See* Emery, K. O. 00099

07448 **Phillips, J. D.; Berggren, W. A.** Influence of continental drift on the distribution of Tertiary benthonic Foraminifera in the Caribbean and Mediterranean regions [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 176, 1969.

07636 **Philpotts, A. R.; Philpotts, John A.** Liquid immiscibility between syenitic and gabbroic magmas [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 176-177, 1969.

**Philpotts, John A.** *See* Philpotts, A. R. 07636

**Phyfer, Daniel W.** *See* Carpenter, John R. 07563

07449 **Pickart, Stanley J.** Physical properties of sulfide materials [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 177-178, 1969.

**Pickett, E. E.** *See* Koirtyohann, S. R. 07257

00174 **Pickett, Thomas E.** New geologic mapping in Delaware [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 31-32, 1970.

07450 **Pierce, J. W.; Colquhoun, D. J.** Evolution of barrier islands [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 178, 1969.

00097 **Pierce, William G.; Nelson, Willis H.** The Heart Mountain detachment fault — A volcanic phenomenon, — A discussion [of paper by C. J. Hughes, 1970]: Jour. Geology, v. 78, no. 1, p. 116-123, illus., 1970.

Neither the dispersed nature of the Heart Mountain fault blocks nor the fault breccia are compatible with the hovercraft mechanism proposed by C. J. Hughes [ibid., p. 107-115]. The upper plate was not emplaced as a coherent sheet; it broke up into numerous blocks soon after movement began, and the blocks became widely separated before movement ceased. If they had been supported initially by high gas pressure, the pressure would have been lost long before the blocks came to rest. The fault breccia was examined at thirty localities; volcanic rock fragments were found only at one, and there they apparently were derived from rocks that are older than the faulting. — *from* Authors' abstract

07451 **Pinder, George F.; Cooper, Hilton H., Jr.** The transient position of the salt water front in coastal aquifers [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 178, 1969.

07637 **Pingitore, Nicholas E., Jr.** Diagenesis and porosity modification in *Acropora palmata*, Pleistocene of Barbados, W. I. [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 178-179, 1969.

**Pitkin, James A.** *See* Flint, George M., Jr. 00193

00095 **Piwinskii, A. J.; Wyllie, P. J.** Experimental studies of igneous rock series — Felsic body suite from the Needle Point pluton, Wallowa batholith, Oregon: Jour. Geology, v. 78, no. 1, p. 52-76, illus., tables, 1970.

Melting relations in an analyzed granite, two quartz monzonites, and a granodiorite were studied at 1, 2, and 3 kb pressure and in the presence of 15 weight percent $H_2O$. The general sequence of melting with increasing temperature from first to last is: K-feldspar, quartz, and plagioclase. Biotite melts before K-feldspar in the granite at less than 1.5 kb and before quartz at all pressures; it melts between quartz and plagioclase in one quartz monzonite at low pressure and even before quartz in the other quartz monzonite at less than 1 kb; it melts before plagioclase in the granodiorite to pressures as high as 2.5 kb. Hornblende was found only in the granodiorite; it melts last, at about 910° - 930°C. Refractive indices of glasses range from 1.485 to 1.503. — FB

**Piwinskii, A. J.** *See* Martin, R. F. 07430

07155 **Plafker, George.** Tectonics of the March 27, 1964, Alaska earthquake: U.S. Geol. Survey Prof. Paper 543-I, p. I1-I74, illus., tables, 1969.

The March 27, 1964, Alaska earthquake was accompanied by crustal deformation over more than 110,000 square miles of land and sea bottom in south-central Alaska. Deformation on land included vertical displacements ranging from 38 feet of uplift to 7-1/2 feet of subsidence relative to sea level, relative seaward horizontal shifts of roughly 64 feet, and subsidiary reverse faulting with dip-slip offsets to 26 feet. Extensive damage was caused by profound shoreline modifications and destructive seismic sea waves related to the tectonic movement. Geologic, geodetic, and geophysical studies of the earthquake-affected region suggest that the primary fault along which displacement occurred is probably a complex thrust fault 550-600 miles long and 110-180 miles wide that dips at less than 15° from the vicinity of the Aleutian Trench beneath the Aleutian Arc. — GP

07255 **Plummer, L. N.** Counting strategy in X-ray emission spectroscopy: Appl. Spectroscopy, v. 23, no. 6, p. 583-586, illus., 1969.

Equations are presented for obtaining greatest precision from available counting time, and minimum counting time for a specified precision in quantitative X-ray spectroscopic analyses. The equations are derived for analytical situations involving determination of the net peak intensity of a line above background and the ratio of the net peak intensities of two lines above one and two backgrounds. Graphical solutions are provided for some of the equations. — Author's abstract

**Podobnik, Donald M.** *See* McGlashan, D. W. 07165

**Podolsky, T.** *See* Naldrett, A. J. 07694

07452 **Pollard, Charles O., Jr.** Semidisplacive mechanism for diagenetic alteration of montmorillonite to illite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 179, 1969.

07453 **Pollard, David D.; Johnson, Arvid M.** Sill-laccolith-bysmalith — Evolution of concordant intrusions in Henry Mountains of Utah [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 180, 1969.

**Porter, Eliot.** *See* Powell, John Wesley. 07171

07455 **Powell, C. McA.** Relict diagenetic textures and structures in regional metamorphic rocks, northern Michigan [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 181, 1969.

07171 **Powell, John Wesley; Porter, Eliot; Fowler, Don D.** Down the Colorado: New York, E. P. Dutton and Co., 168 p., illus., 1969.

This handsomely illustrated folio contains: (1) a foreword on the history of the exploration of the Grand Canyon of the Colorado by Fowler; (2) Powell's diary of the first trip through the Grand Canyon, 1869; and (3) an epilogue on the canyons of the Colorado, past and present, 1969, by Porter, in which the pollution of Lake Powell, historical geology of the Canyon, and present-day exploration of the canyon are outlined. — MCM

07154 **Powell, Richard L.** Unconsolidated deposits on the Mitchell Plain of Indiana [abs.]: Indiana Acad. Sci. Proc. 1968, v. 78, p. 316, 1969.

07456 **Presley, B. J.; Kaplan, I. R.** Heavy metals in the interstitial water of marine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 182, 1969.

07100 **Press, Frank.** Zero frequency seismology, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 171-173, table, 1969.

Observation and interpretation of long-term displacements, strains, and tilts ("zero frequency" seismology) are important for evaluation of the residual displacement, strain, and tilt fields associated with earthquakes and the changes in these fields reflecting tectonic strain accumulation. The data contribute to the study of orogeny, volcanism, and earthquake mechanisms. Signal sources pertinent to zero frequency seismology are tabulated, and the capabilities of several techniques for measuring the signals are discussed. — MS

07457 **Press, Frank.** A mechanism for creation of the suboceanic lithosphere [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 182, 1969.

07458 **Press, Frank.** Prospects for earthquake prediction and control [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 182-183, 1969.

07579 **Price, Raymond A.** The southern Canadian Rockies and the role of gravity in low-angle thrusting, foreland folding, and the evolution of migrating foredeeps [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 284-286, 1969.

07110 **Putman, George W.; Alford, John T.** Geochemistry and petrology of the Rocky Hill stock, Tulare County, California: Geol. Soc. America Spec. Paper 120, 109 p., illus., tables, 1969.

This stock intrudes metamorphosed ultramafic and metavolcanic rocks in the western Sierra Nevada near Visalia, with sharp and steeply dipping contacts. Massive granodiorite shows weak, steep plunging lineation and planar grain fracture; aplite dikes are common; and ellipsoidal inclusions up to three feet long occur sparsely in

rim-facies, but are rare in core-facies where chloritization is most intense and sulfide content higher. Quantitative analyses show regional variation of trace elements in ferromagnesian minerals; petrographic properties are chemically similar with small modal differences. A single, near vertical intrusion of fluid magma is indicated, which crystallized progressively inward until quenched by isothermal pressure of saturated volatiles to produce the core matrix, and force aplite into rock fractures. A cylinder model, consistent with a gravity anomaly over the stock, has a 7,000-ft diameter and depth of over 16,000 feet. — GDC

07222 **Pye, E. G.** (editor). Summary of field work, 1969, by the Geological Branch: Ontario Dept. Mines Misc. Paper 32, 70 p., illus., table, 1969.

In 1969, the Branch placed 20 geological parties, 2 geochemical parties, and a geophysical party in the field, on 29 different projects. Locations of the areas investigated are shown on a map, and results outlined in short reports by each of the project leaders, emphasizing the economic aspects. It is hoped that this will help in the selection of favorable areas for prospecting. Colored maps and detailed reports are being prepared for publication, and in the interim, preliminary geologic maps with marginal notes will be released. — ESL

**Pytkowicz, R. M.** *See* Hawley, J. 07185

**Quinn, A. W.** *See* Foland, K. A. 00155

07337 **Raab, Werner Joseph.** Solubilities of stibnite, orpiment and realgar in borate, carbonate and hydroxide solutions as functions of temperature and pressure and their implications as applied to the borax deposit at Boron, California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2255B-2256B, 1969.

07459 **Rabinowitz, Philip D.; Talwani, Manik.** Gravity anomalies in the western North Atlantic [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 184, 1969.

**Ragland, Paul C.** *See* Butler, J. Robert. 07310

00175 **Rahn, Perry H.** The weathering of tombstones, and its relationship to the topography of New England [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 32, 1970.

07756 **Raitt, Russell W.** Anisotropy of the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 250-256, illus., table, 1969.

Results of observations on seismic wave anisotropy in the Flora and Quartet areas off the coast of California support but do not necessarily prove the existence of anisotropy throughout the region. Velocity variation may be partly due to anisotropy but may also reflect a geographic effect associated with a systematic dependence of azimuth on position. — MS

07460 **Raleigh, C. B.** Rate dependence of the flow mechanism in ultramafic minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 184-185, 1969.

07731 **Ranney, Richard W.; Beatty, Marvin T.** Clay translocation and albic tongue formation in two Glossoboralfs of west-central Wisconsin: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 768-775, illus., table 1969.

Particle-size and mineralogical analyses indicate that albic tongues in the upper B horizon are formed primarily by physical removal of clay. Albic tongues in the lower B horizon have apparently been formed, at least in part, by other processes involving movement of silt and sand. Coarse clay (2-0.2$\mu$) from eluvial zones has a greater proportion of quartz and feldspars than coarse clays from the illuvial zones. Fine illuvial clay (<0.2$\mu$) from B3 horizon cutans is mineralogically very similar to the fine clay from the rest of the soil. This indicates that clay translocation in those soils has occurred primarily by movement of clay particles in suspension without appreciable dissolution of crystal structures. — Soil brief

07461 **Raring, A. W.; Bergström, S. M.; Schopf, T. J. M.** Correlation of the Middle Ordovician type Chazy (New York and Vermont) with the type Marmor, Ashby and Porterfield (southern Appalachians) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 185-186, 1969.

00176 **Ratcliffe, Nicholas M.; Shuart, Susan G.** The Rosetown complex and its bearing on the antiquity of the Ramapo fault system [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 32-33, 1970.

07462 **Rathnam, Venkata K.** Source and dispersal of relict sediments on the Bering shelf [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 186, 1969.

07623 **Ray, Louis L.** Glacial erratics and the problem of glaciation in northeast Kentucky and southeast Ohio — A review and suggestion, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D195-D199, illus., 1969.

The mode of transportation and emplacement of glacial erratics in northeastern Kentucky and southeastern Ohio, first reported in the early years of this century, has not been adequately explained despite the several proposed hypotheses. The problem is reviewed, and the suggestion is made that a glacial advance, possibly of Nebraskan age, extended somewhat beyond the mapped limits of glaciation in southern and southeastern Ohio and into northern Kentucky. Such an advance would provide for emplacement of the glacial erratics through ice rafting. It is further suggested that until this problem is solved by field and laboratory studies, the regional Quaternary history can not be explained, nor can the Quaternary disruption of the preglacial Teays drainage system and the development of the present Ohio River. — Author's abstract

**Raymond, Dorothy E.** *See* Neathery, Thornton L. 07696

**Reed, J. C.** *See* Reed, J. C., Jr. 07596

07596 **Reed, J. C., Jr.; Reed, J. C.** Gold veins near Great Falls, Maryland: U.S. Geol. Survey Bull. 1286, 22 p., illus., 1969.

Small deposits of native gold are present along an anastomosing system of quartz veins and shear zones just east of Great Falls, Montgomery County, Md. The deposits were discovered in 1861 and were worked sporadically until 1951, yielding more than 5,000 ounces of gold. The vein system and principal veins within it strike a few degrees west of north, at an appreciable angle to foliation and fold axial planes in enclosing rocks of the Wissahickon Formation of late Precambrian(?) age. The veins cut granitic rocks of Devonian or pre-Devonian age and may be as young as Triassic. Further development of the deposits is unlikely under present economic conditions because of their generally low gold content and because much of the vein system lies on park property, but study of the Great Falls vein system may be useful in the search for similar deposits elsewhere in the Appalachian Piedmont. — Authors' abstract

**Reed, John C., Jr.** *See* Gilluly, James. 00102

**Reed, L. W.** *See* Kidder, Gerald. 07223

07338 **Rehkemper, Leonard James.** Sedimentology of Holocene estuarine deposits, Galveston Bay, Texas [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2256B, 1969.

07339 **Rehrig, William Allen.** Fracturing and its effects on molybdenum mineralization at Questa, New Mexico [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2256B-2257B, 1969.

**Reid, I. A.** *See* Campbell, P. I. 07121

**Reiser, H. N.** *See* Brosgé, W. P. 07721

07351 **Renick, Howard, Jr.** Magnetotelluric investigations in the area of the Tobacco Root Mountains, southwestern Montana; southeastern Montana; and southern Illinois, Indiana, and Ohio [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2263B, 1969.

07463 **Reso, Anthony.** The Mid-Cretaceous paleontological break [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 186-187, 1969.

07464 **Revetta, Frank A.** A regional gravity survey of New York and eastern Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 187, 1969.

**Rex, Robert W.** *See* Margolis, Stanley V. 07576

07370 **Reynolds, Mitchell William.** Stratigraphy and structural geology of the Titus and Titanothere Canyons area, Death Valley, California [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2257B, 1969.

**Rezak, Richard.** *See* Bouma, Arnold H. 07562

**Rhindress, Richard C.** *See* Emrich, Grover H. 00150

07668 **Rhodes, J. R.; Furuta, T.; Berry, P. F.** A radioisotope X-ray fluorescence drill hole probe, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 353-363, illus., discussion, 1969.

A radioisotope X-ray fluorescence drillhole probe of prototype design is described. The main potential application of such an instrument is for logging uncased and preferably dry drillholes in metalliferous ore deposits; for example, to locate cut-off horizons during development mining operations. A double scintillation detector arrangement is used, with balanced filters. The geometry of the source-detector assembly pays high regard to the importance of cylindrical symmetry and utilizes a simple design and inexpensive components. Initial results have been obtained for silver and uranium in concrete standards. Preliminary field tests on a model uranium borehole are also described. Sensitivities of 0.015 wt. percent Ag and 0.15 wt. percent U in 10-sec measurement times were obtained, and further improvements by at least a factor of two are shown to be possible. — Authors' abstract

**Ribar, B.** *See* Nowacki, W. 07704

07465 **Ribbe, P. H.; Gibbs, G. V.** Mg/Fe ordering in humite, $Mg_{4.6}Fe_{0.4}Si_3O_{12}F(OH)$ [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 188, 1969.

07734 **Rich, C. I.** Suction apparatus for mounting clay specimens on ceramic tile for X-ray diffraction: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 815-816, illus., 1969.

A simple suction apparatus for preparing clay mineral specimens for X-ray diffraction on unglazed ceramic tile is described. A large rubber stopper is modified by forming a molded recess with silicon rubber to reduce air leakage about the tile. Specimens of proper thickness can be prepared quickly with the apparatus. — Author's abstract

07466 **Richard, Kenyon.** Process of formation of mineralized breccia pipes [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 188, 1969; Econ. Geology, v. 64, no. 7, p. 832, 1969.

00177 **Richards, Adrian F.; Keller, George H.** Geotechnical properties of sediments in the Wilkinson basin, Gulf of Maine [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 33, 1970.

07467 **Richards, Adrian F.; Bryant, William R.; Keller, George H.** In-place shear strength measured in abyssal plain sediments, Gulf of Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 188-189, 1969.

00202 **Richer, Kenneth A.** Comments on "A microwave radiometric study of buried karst topography" [by J. M. Kennedy, 1968]: Geol. Soc. America Bull., v. 81, no. 2, p. 585-587, illus., table, 1970.

Temperature variations measured above buried caves probably result from variations in surface moisture and slope. Reflections from the cave-earth interface cannot be detected because microwave energy cannot penetrate damp earth to any significant dept. [Original paper, ibid., v. 79, no. 6, p. 735-742, 1968.]

07108 **Rickard, Lawrence V.** Stratigraphy of the Upper Silurian Salina Group, New York, Pennsylvania, Ohio, Ontario: New York State Mus. and Sci. Service Map and Chart Ser., no. 12, 57 p., illus., 1969.

Study and correlation of 435 sample and gamma-ray logs of the Salina Group reveal detailed stratigraphy of the evaporite sequence. Nearly identical subdivisions can be traced across the arches dividing the Michigan and Appalachian basins; formations named from exposures on the margin of the Appalachian basin can be correlated with subsurface units established by Landes for the Michigan basin. Gamma-ray logs suggest that thick halite beds formed very rapidly relative to intervening rock and anhydrite layers. Nine isopach and lithofacies maps and four cross sections accompany the report. Appendix A identifies the control wells; B gives subsurface data from them; and C gives values selected as appropriate intervals in the Salina depositional model. — ESL

**Riedel, William R.** *See* Winterer, Edward L. 07550

07066 **Rikitake, Tsuneji.** Conductivity anomaly of the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 463-469, illus., 1969.

The causes for geomagnetic variation anomalies such as those observed in Japan, Peru, and elsewhere are not yet known but can tentatively be explained as related to undulations of highly conducting regions of the mantle, probably associated with corresponding undulations of isotherms. — MS

07058 **Ringwood, A. E.; Green, D. H.** Phase transitions, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 637-649, illus., tables, 1969.

Results of investigations on the gabbro-eclogite transformation, the stability fields of mineral assemblages in the upper mantle to a depth of 400 km, and phase transitions in the transition zone to depths of 900 km support various conclusions such as those postulating that eclogite is thermodynamically stable throughout the normal crust, that the olivine and pyroxene of upper mantle material are unstable at high pressures and transform to denser phases at depths between 300 and 600 km, and that the pyroxene-garnet transition is probably the first major transformation, followed or overlapped by the olivine-spinel transition. More densely packed polymorphs occur below 600 km. — MS

**Ringwood, A. E.** *See* Green, D. H. 07070

07087 **Ringwood, A. E.** Composition and evolution of the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 1-17, illus., tables, 1969.

Geophysical, geologic, and other evidence is presented in support of the conclusion that the upper mantle is dominantly ultramafic rather than eclogitic in composition. Two distinct types of differentiation processes, characterized by vertical and lateral mass transport, resulted in generation of crustal from mantle material. Fractional melting of the mantle and transport of low-melting components involved in the vertical differentiation process led to formation of a residual ultramafic zone in the mantle. Fractional melting associated with lateral differentiation processes is probably a factor in the process of sea-floor spreading. — MS

**Ripley, Leonard G.** *See* Nickel, Ernest H. 07730

07095 **Ritsema, A. R.** Seismology and upper mantle investigations, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 110-115, 1969.

Improved instrumentation and developments in the acquisition and computer processing of data have contributed to rapid advances in seismic investigations of the crust and upper mantle. It is now known that there is significant lateral inhomogeneity not only in the crust but in the upper mantle. Models of crustal and mantle dynamics, types of movements in earthquake foci, and motions in tension areas are cited as examples of the results of recent investigations. — MS

07468 **Ritter, Dale F.; Born, Stephen M.** Modern terrace development near Pyramid Lake, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 189-190, 1969.

07124 **Ritzma, Howard R.** Oil-impregnated sandstone deposits of Utah — A progress report: Interstate Oil Compact Comm. Comm. Bull., v. 11, no. 2, p. 24-34, illus., 1969.

Since 1967 the Utah Geological Survey has been mapping and analyzing the oil-impregnated rock deposits of Utah. Almost all the 40 known deposits have been visited and the more important mapped. Distribution is shown. A circle of deposits outlines the Uinta basin, which was occupied during the Eocene by a shallow lake in which the Green River Formation was deposited, oil content of which is measurable in trillion of barrels. Solid-hydrocarbon dikes also occur. A group of deposits in central-southeast Utah include two large deposits, and occur in Jurassic and older rocks. The Tar Sand Triangle and Circle Cliffs deposits are described in more detail. — ESL

**Roberson, Charles E.** *See* Schoen, Robert. 07480

07580 **Roberts, Ralph J.** The Cordilleran continental margin — Continental collisions vs. geotectonic cycles [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 286-288, table, 1969.

07630 **Robertson, John B.** Diffusion from a gaseous source in a porous medium — A field and theoretical comparison, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D265-D273, illus., 1969.

Small volumes of air containing a radioactive krypton-85 tracer were injected into fine-grained sediments at the National Reactor Testing Station, Idaho. Dissipation of the $Kr^{85}$ gas away from the injection points was observed by recording the gamma radioactivity in the holes. A mathematical model was adapted from a heat-flow analogy to estimate the amount of molecular diffusion occurring in the system. The observed field data match the theoretical diffusion curves closely, indicating that most of the observed outflow was due to diffusion. — Author's abstract

07591 **Robinson, J. E.; Charlesworth, H. A. K.** Spatial filtering illustrates relationship between tectonic structure and oil occurrence in southern and central Alberta, *in* Symposium on computer applications in petroleum exploration: Kansas Geol. Survey Computer Contr. 40, p. 13-18, illus., 1969.

Structural contour maps commonly express a combination of features whose relief and spacing differ widely. In analyzing individual features, spatial filtering permits suppression of all features outside a specified range or trend. The process is an application of Fourier theory allowing any contourable feature to be expressed in terms of a limited range of sinusoidal surfaces, and requires use of a digital computer. Application of spatial filtering techniques to structure contour and topographic maps in central Alberta indicates a series of features forming two structural trends, perpendicular to each other, with the most prominent aligned NE-SW. They are interpreted as the result of repeated adjustments of tabular blocks in the Precambrian. Northeast of Edmonton there is evidence of a pre-Cretaceous wrench fault, making the NW-SE trend more prominent. Both trends have influenced oil and gas accumulation. — *from* Authors' abstract

07735 **Roen, John B.; Hosterman, John W.** Analyses and potential uses of selected shales and clays, Greene County, Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Inf. Circ. 67, 29 p., illus., tables, 1969.

Seven clay and shale samples from the Pittsburgh, Waynesburg, Washington, and Greene Formations of Pennsylvanian and Permian age from Greene County, Pa., were analyzed to determine their potential commercial use. Chemical, semiquantitative sprectrographic, and X-ray analyses were performed. The chemical and mineral compositions of these clays and shales indicate that they cannot be used in the high-grade refractory industries. Slow-fire tests were conducted on all seven samples, and all but one were judged suitable for the manufacture of common, face, and decorative brick. Four samples had expansion characteristics after slow-fire tests and were then quick fired to determine their bloating properties. Three of the four quick-fired samples were fired in the laboratory rotary kiln. One was found to be marginal and one was suitable for the production of lightweight aggregate. — Authors' abstract

**Rogers, W. S.** *See* Spencer, R. S. 00087

07230 **Romey, William D.** The need for flexibility in introductory geology courses: Jour. Geol. Education, v. 17, no. 5, p. 193-195, 1969.

The pressure of numbers in beginning courses may increase as students who took ESCP earth science begin to arrive in college. Most present geology majors made the decision to make geology their career in the first-year course, which means that a careful evaluation of experience given to beginning students is needed. During 1968-69, in an introductory geology course at Syracuse University students elected to study geomorphology and paleontology in the last four weeks. They were allowed to choose their own problems and investigate them; individual students or teams reported on their results. Student-initiated criticism led to re-examination of data and further study. Only 18 students out of 115 preferred the conventional type of laboratory exercise. Examinations indicated at least as much learning in the free laboratories as in the conventional. Methods of evaluating work on this system are discussed. —ESL

07469 **Romey, William D.; Fenner, Peter.** Teaching-assistant training aid — Closed-circuit television [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 191, 1969.

00101 **Rona, Peter A.** Comparison of continental margins of eastern North America at Cape Hatteras and northwestern Africa at Cap Blanc: Am. Assoc. Petroleum Geologists Bull., v. 54, no. 1, p. 129-157, illus., tables, 1970.

With some exceptions and qualifications, the opposing continental margins of Cape Hatteras and Cap Blanc appear broadly symmetric with respect to (1) distribution of physiographic provinces, (2) early and middle Paleozoic, Mesozoic, and Cenozoic stratigraphic framework, (3) late Precambrian, Paleozoic, and Mesozoic tectonic framework, and (4) certain offshore residual magnetic anomalies. The margins are broadly asymmetric with respect to Cenozoic tectonic framework. The apparent symmetry in space and time of various tectonic deformation effects on tehe margins is consistent with the sea-floor spreading concept. Limited data suggest that epeirogenic subsidence of the margins and inferred sea-floor spreading are related genetically. — EGS

07754 **Rones, Morris.** A lithostratigraphic, petrographic and chemical investigation of the lower Middle Ordovician carbonate rocks in central Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. (Gen. Geology Rept.) G 53, 224 p., illus., tables, 1969.

Through coordinated, detailed field and laboratory studies, understanding has been gained of facies relations of map units of Black River and lower Trenton age. A new formation, Linden Hall, is named to replace the terms Curtin and Benner. The Oak Hall Member (lower Nealmont) is found to be a facies equivalent of the Curtin Formation (Black River) and is therefore removed from the Trenton and made the upper member of the Linden Hall Formation. The Snyder Member of the Benner is raised to Formation rank. The sequence now established is: (1) Trenton — Nealmont Formation (Rodman and Center Hall Members); (2) Black River — Linden Hall Formation (Oak Hall and Stover Members), and Snyder and Hatter Formations. Facies are analyzed in terms of relations to shorelines, tectonic environment, and their cyclic nature. — *from* Author's abstract

07089 **Ronov, A. B.; Yaroshevsky, A. A.** Chemical composition of the Earth's crust, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 37-57, illus., tables, 1969.

Two independent methods of calculation resulted in identical compositions of the granitic shell and substantiated the theory of the geosynclinal origin of metamorphic rocks of shield areas. The basalt shell consists of a continental and an oceanic part, differing in structure and composition. Solution of the problem of its composition is more difficult, and is approached from the premise that in continental crust its petrographic and chemical composition gradually changes with depth from a composition similar to that of the granitic shell to a composition corresponding to a geosynclinal-type continental basalt. The oceanic part consists mainly of tholeiitic basalts. Discussion of the chemical constitution of the sedimentary shell is also included. Origin of the shells is attributed to ascent and differentiation of mantle material and reworking of the crustal material by surface processes. Extensive chemical and abundance data are reported. — MS

**Rosauer, E. A.** *See* Merchant, S. R. 07266

07471 **Rose, Arthur W.** Origin of wallrock alteration at porphyry copper deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 192, 1969.

00212 **Rosenberg, Gary, D.** Botanical criteria for differentiating eustatic and relative fluctuations in sea level: Geol. Soc. America Bull., v. 81, no. 2, p. 525-528, illus., 1970.

Coastal vegetation is zoned relative to the shore, with flora nearest the shore most tolerant to sea water. This geographic distribution of plants is also repeated temporally. Vegetation tolerant to sea water colonizes newly emerged coasts; as time passes, increasingly terrestrial vegetation replaces the pioneer species. The more inland, terrestrial flora thus marks the position of older shorelines. Coasts subsiding nonuniformly are characterized by older shorelines lying closer to the coast in rapidly sinking areas. Applied to the Florida Peninsula, this reasoning suggests that the known Holocene transgression of the state is not purely eustatic. — Author's abstract

07472 **Rosenberg, P. E.** Topaz-vapor equilibria in the presence of excess silica and water [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 192-193, 1969.

07473 **Ross, Charles A.** Late Paleozoic marine faunal provinciality [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 193, 1969.

**Ross, D. C.** *See* Dodge, F. C. W. 07566

00210 **Ross, Reuben James, Jr.; Ingham, J. Keith.** Distribution of the Toquima-Table Head (Middle Ordovician Whiterock) Faunal Realm in the Northern Hemisphere: Geol. Soc. America Bull., v. 81, no. 2, p. 393-408, illus., tables, 1970.

Discovery of a Whiterock trilobite assemblage in the Albany Mudstone, Girvan District, southwestern Scotland, led to an assessment of the distribution of Middle Ordovician brachiopod and trilobite faunas previously assigned to the Whiterock Stage of Cooper (1956). These faunas lie within a belt designated as the Toquima-Table Head Faunal Realm. This realm is closely related to the position of the transition from miogeosynclinal to eugeosynclinal facies, presumed to indicate the position of Ordovician continental margins. In Middle Ordovician time North America, parts of Ireland, Scotland, Norway, Sweden, and northeastern Asia may have constituted a single continental mass. — Authors' abstract.

07263 **Roth, C. B.; Jackson, M. L.; Syers, J. K.** Deferration effect on structural ferrous-ferric iron ratio and CEC of vermiculites and soils [with French, German, and Russian abs.]: Clays and Clay Minerals, v. 17, no. 5, p. 253-264, illus., tables, 1969.

Appreciable decrease in $Fe^{3+}$ and reciprocal increase in $Fe^{2+}$ of micaceous vermiculites from various localities, soils, nontronite and muscovite occur under strongly reducing conditions. Under subsequent $H_2O_2$ treatment the $Fe^{3+}$ content is returned

to nearly original amount. The cation exchange capacity (CEC) increase resulting from deferration, which remained through subsequent reoxidation of structural iron, is attributed to removal of positively charged sesquioxide coatings that blocked exchange sites. The neutralization of additional positive charge arising from the change in iron valence may involve deprotonation of structural $OH^-$ to $O^{2-}$ in the phyllosilicate layer, the reactions being reversible. — GDC

07228 **Roth, Robert A.** Earth science and Ohio: Jour. Geol. Education, v. 17, no. 5, p. 185-187, tables, 1969.

Ohio has experienced a significant increase in its earth science enrollment, without a proportionate change in the teacher training programs and teacher certification. It is necessary that a definite program be adopted for a gradual step-by-step improvement of the earth science certification requirements. This in turn could influence teacher training programs and, as a result, improve the quality of earth science instruction. — Author's summary

**Rovig, A. D.** *See* McGlashan, D. W. 07165

**Rowe, J. J.** *See* Gottfried, David. 07572

**Roy, Robert F.** *See* Simmons, Gene. 07092

**Roy, Rustum.** *See* Dachille, Frank. 07205

07243 **Ruch, R. R.** Radiochemical separation of gold by amalgam exchange [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 643, 1969.

**Ruch, R. R.** *See* Kim, Stephen M. 07244

**Rucklidge, J. C.** *See* Naldrett, A. J. 07694

07162 **Runcorn, S. K.** Convection in the mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 692-698, illus., 1969.

With reference to results of mathematical analysis supporting the premise that a single physical cause is responsible for presently active compressional and tensional tectonic features, arguments are presented in support of convection in the mantle as the mechanism responsible for these features and for continental drift and other processes involved in the development of the Earth's structure. The contraction theory of mountain building, involving an Earth cooling by conduction, falls short of a satisfactory explanation by an order of magnitude. — MS

07757 **Runcorn, S. K.** The paleomagnetic vector field, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 447-457, illus., 1969.

The remanent magnetization of oriented rock samples from various geologic formations is an index of the magnetic field directions in different continents in the geologic past. The geomagnetic field varies with three different time scales — secular variation and polarity reversals, both in the order of 100 to 10,000 years, and variations on a scale of hundreds of millions of years, which are explained in terms of polar wandering and continental drift. The various ways in which permanent magnetization can be acquired are summarized and the application of paleomagnetic data to reconstructions of the continents and interpretations of tectonic crustal movements is discussed. — MS

**Rupert, J. Paul.** *See* Wright, Alan C. 07206

07474 **Russell, Kenneth L.** Geochemistry and halmyrolysis of clay minerals, Rio Ameca, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 194, 1969.

**Rust, R. H.** *See* Verma, Shive D. 07647

07475 **Rutstein, Martin S.** Re-examination of the wollastonite ($CaSiO_3$)-hedenbergite ($CaFeSi_2O_6$) solvus [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 194-195, 1969.

07132 **Rutter, N. W.; Wyder, J. E.** Application of borehole stratigraphic techniques in areas of mountain glacial drift in Alberta, Canada: Canada Geol. Survey Paper 69-35, 16 p., illus., 1969.

An integrated program of drilling, side-wall sampling, and single-point electrologging was carried out in mountain glacial drift near Canmore and Calgary to obtain stratigraphic information not acquired by conventional techniques. Reports from most test drilling programs using rotary hydraulic drills have consisted of descriptions of chips carried to the surface by drilling mud. Chip samples by themselves do not provide sufficient evidence for determination of detailed stratigraphy in areas of rapid lateral and vertical changes in lithology, whereas side-wall sampling techniques and electro-logs proved valuable stratigraphic tools, readily eliminating ambiguities arising from examination of chip samples alone. Results were useful in confirming stratigraphic relations based on previous surface mapping, extending geological boundaries, determining thickness of, and discovery of new, lithologic units. — *from* Authors' abstract

07638 **Ryan, J. Donald.** Late Upper Cretaceous and early Tertiary paleocurrent patterns in the Hanna and Carbon Basins, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 195, 1969.

**Rydell, H. S.** *See* Kaufman, M. I. 07126

07340 **Rydell, Harold Stanford.** The implications of uranium isotope distributions associated with the Floridan aquifer of north Florida [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2258B, 1969.

07476 **Rye, Robert O.; Czamanske, Gerald K.** Experimental determination of sphalerite-galena sulfur isotope fractionation and application to the ores at Providencia, Mexico [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 195-196, 1969.

07268 **Saad, Afif Hani.** Magnetic properties of ultramafic rocks from Red Mountain, California: Geophysics, v. 34, no. 6, p. 974-987, illus., tables, 1969.

A representative ultramafic intrusion at Red Mountain southeast of San Francisco, Calif., was sampled in order to study the remanent magnetism and susceptibility of ultramafic rocks as functions of serpentinization. The data suggest that it is mainly a chemical remanent magnetization that is acquired during the process of serpentinization. The intensity of both remanent and induced magnetization increases exponentially with serpentinization, although the CRM becomes highly unstable as the rock becomes intensely serpentinized. The intensity of magnetization also depends on mode of occurrence and state of oxidation of the magnetite, and on original rock composition. — GV

07477 **Sadlick, Walter; James, Keith H.** Factor analysis, entropy and evolution [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 196, 1969.

07120 **Safford, Frederick B.** (compiler). Subsurface information catalog, 1963-1967: Ohio Div. Geol. Survey Inf. Circ. 35, 58 p., tables, 1969.

The second in a series of supplements to Inf. Circ. 31, 1962 (Calvert), this catalog includes data on geophysical logs, well cuttings, cores, core chips, and sample descriptions which have been added to the files of the Subsurface Section of the Ohio Division of Geological Survey from June 30, 1963, through December 31, 1967. — MCM

**Saint Julien, P.** *See* Stevens, R. K. 07507

07642 **Saito, Tsunemasa.** Late Cenozoic stage boundaries in deep-sea sediments [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 289-290, 1969.

**Sandberg, G. W.** *See* Handy, A. H. 07626

**Sanders, John E.** *See* Kumar, Naresh. 00166

00178 **Sanders, John E.; Kumar, Naresh; Friedman, G. M.** Shelf-edge carbonates — Anomalies to conventional ideas relating Quaternary climates and sea levels [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 34, 1970.

07478 **Sanders, Robert B.** Information structure of descriptive paleontological studies [abs.]: Geol. Soc. America Abs. with Programs1969, pt. 7, p. 197, 1969.

07742 **Santos, G. G.; Fite, L. E.; Kuykendall, W. E.; Wainerdi, R. E.; Bouma, A. H.; Bryant, W. R.** Preliminary study on the use of fast-neutron activation analysis on sea-floor compositional mapping, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 463-487, illus., tables, discussion, 1969.

A recent demonstration of a small 14-MeV neutron activation analysis system to differentiation between types of igneous rocks and lavas indicates that by measuring O, Al, Si, Fe, and Mg of different rocks, a successful qualitative identification of complex rock types is possible. In this study fast-neutron activation was applied to marine sediments. Sediments for analysis were collected from different depositional environments of the Gulf of Mexico. Results indicate that on the basis of Si content alone abyssal plain sediments can be differentiated from continental slope, abyssal hills, continental rise, and the Mississippi fan; Fe, Mg, and Al may be used to gauge subtle variations within an environment. It would be feasible to perform the analysis "in situ". —*from* Authors' abstract

07479 **Sawkins, Frederick J.; Petersen, Ulrich.** A tectonic-genetic classification of sulfide ore deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 197-198, 1969; Econ. Geology, v. 64, no. 7, p. 835, 1969.

07207 **Schenck, P. A.; Havenaar, I.** (editors). Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), 617 p., illus., tables, 1969.

This volume contains the proceedings of the fourth International Meeting on Organic Geochemistry which was organized by the European Branch of the Geochemical Society's Organic Geochemistry Division. Four invited speakers presented a general review on the state of affairs in several fields, such as organic compounds in sediments, geochemistry of petroleum, and of coal, and organic geochemistry of the oceans; the paper by G. T. Philippi is cited separately. Six of the 36 contributed papers which follow the general review are cited also. — GDC

**Schlocker, J.** *See* Gray, D. H. 07265

00179 **Schmalz, Robert F.** Surface energy measurements for calcite, and textural equilibria of carbonate cements [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 34-35, 1970.

07153 **Schneider, Allan F.** A significant exposure of Pleistocene drift in south-central Indiana [abs.]: Indiana Acad. Sci. Proc. 1968, v. 78, p. 315-316, 1969.

**Schneider, Eric D.** *See* Vogt, Peter R. 07055

07581 **Schneider, Eric D.** Models for rifted and compressional continental margins [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 291-292, illus., 1969.

**Schnoes, Heinrich K.** *See* Burlingame, A. L. 07209

07480 **Schoen, Robert; Roberson, Charles E.** Structures of aluminum hydroxide and geochemical implications [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 198-199, 1969.

07481 **Schopf, J. William.** Micropaleontology and extraterrestrial sample studies [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 200, 1969.

**Schopf, T. J. M.** *See* Raring, A. W. 07461

07482 **Schopf, T. J. M.; Allen, J. R.** Microprobe analysis showing Ca, Mg, Sr and P distributions in skeletons of the phylum Ectoprocta [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 200-201, 1969.

07483 **Schram, Frederick R.** Insights into the evolution of the Syncarida (Crustacea: alacostraca) [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 201, 1969.

**Schreyer, W.** *See* Langer, K. 07201

00180 **Schwab, Frederic L.** Petrology, paleocurrents, and depositional environments of the Harpers Formation in the central Appalachians [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 35, 1970.

07484 **Schwab, Frederic L.** Petrology, paleocurrents, and depositional environment of the Antietam Formation in the central Appalachians [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 201-202, 1969.

**Schwartz, Leander J.** *See* Weis, Leonard W. 07283

07341 **Scott, David Holcomb.** The geology of the southern Pancake Range and Lunar Crater volcanic field, Nye County, Nevada [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2258B, 1969.

**Scott, Ralph G.** *See* Huffman, Michael E. 07382

07485 **Scott, S. D.; Barnes, H. L.** Sphalerite geobarometry [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 202-203, 1969.

07486 **Scrudato, Ronald J.** Origin of east-central Georgia kaolin deposits [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 203, 1969; Econ. Geology, v. 64, no. 7, p. 834, 1969.

07258 **Seckel, Hansjörg; Stober, Manfred.** Höhenänderung des grönländischen Inlandeises 1959-1968 [with English abs.]: Polarforschung 1968, v. 38, pt. 6, nos. 1-2, p. 215-221, illus. [1969].

The members of the two International Glaciological Greenland Expeditions (EGIG) in 1959 and 1968 determined the altitudes in the west-east profile by levelling. The comparison of these two measurements gives evidence of the change of altitudes and of the surface-waves. The ways of measurement and of analysis are described here. The graphic representation of the result is discussed here in connection with the possible causes. — Authors' abstract

07321 **Seegmiller, Ben Lorin.** Correlation and detection of wave velocity and stress [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2216B, 1969.

07487 **Seeland, David A.** Cambrian winds of the north-central and northeast United States [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 203-204, 1969.

**Seifert, K. E.** *See* Onyeagocha, A. C. 07708

07746 **Seiglie, George A.; Bermúdez, Pedro J.** Some foraminifers of the genus *Reophax* and description of a new genus: Tulane Studies Geology and Paleontology, v. 7, no. 4, p. 193-203, illus., 1969.

*Reophax caribensis*, sp. nov., is described. It is provided with a friable test composed of poorly cemented grains, generally laminar, and lives in shallow waters [type locality off west coast of Puerto Rico]. It is compared with similar species, especially with *R. dentaliniformis* Brady. *Glaucoammina*, gen. nov., is described and included in the family Lituolidae. The type species is *Reophax trilateralis* Cushman. This foraminifer is very variable in shape and lives on the outer submarine shelves of the Caribbean

Sea. The test is composed of well cemented grains, mainly of glauconite, calcite, or dark minerals, or a combination of these [indicating mildly anaerobic conditions and a low rate of sedimentation]. — Authors' abstract

07488 **Semec, Branko; McDougall, David J.** Thermal modification of the thermoluminescence of fluorite [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 204, 1969.

**Semken, Holmes A.** *See* Nelson, Robert S. 07698

**Senftle, Frank E.** *See* Vaz, J. Eduardo. 07531

00181 **Sevon, William D.** Mississippian unconformity in northeastern Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 35-36, 1970.

**Sharman, G. F., 3d.** *See* Chase, C. G. 00209

**Shastal, J.** *See* Campbell, P. I. 07121

07625 **Shawe, Fred R.; Gildersleeve, Benjamin.** An anastomosing channel complex at the base of the Pennsylvanian system in western Kentucky, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D206-D209, illus., 1969.

Mapping in western Kentucky has partly delineated a complex, anastomosing channel system at the base of the Pennsylvanian System. This channel complex is found at the margins of, and at altitudes reaching a maximum of about 120 feet above, a major westward-trending trunk channel. Fill in the main and subsidiary channels is dominantly sandstone, but it includes conglomerate, conglomeratic sandstone, siltstone, shale, and coal. The shape of channel walls is generally controlled by the varied resistance to erosion of different Mississippian rocks in which the channel is cut. In a few places, faults have controlled the position of a channel or the shape of a channel wall. — Authors' abstract

07363 **Shearman, D. J.; Fuller, J. G. C. M.** Phenomena associated with calcitization of anhydrite rocks, Winnipegosis Formation, Middle Devonian of Saskatchewan, Canada: Geol. Soc. London Proc. 1969, no. 1658, p. 235-237; discussion, p. 237-239, 1969.

Unreplaced anhydrite relics within coarsely crystalline diagenetic calcite show the original crystal fabric, an open framework of laths. Equivalents in uncalcitized parts were tightly packed aggregates of crystals; lateral change was often within a core width. In calcitized parts, aggregate anhydrite laths formed nodules in layers which, when coalesced into a solid mass, exhibited enterolithic structure; this was less apparent in compacted equivalents. Nodule layers were separated by calcite crystals containing organic matter, which in uncalcitized parts formed thin bituminous films meshed like chicken-wire, their flattened cells compacted subsequent to the calcitizing processes. The anhydrite, generally considered a relatively deep-water deposit, was apparently early diagenetic in origin; the organic matter could have been an algal mat, and the sediments accumulated on shallow intertidal flats and shoals. — GDC

**Sheppard, Richard A.** *See* Gude, Arthur J., 3d. 07357

07608 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Authigenic fluorite in Pliocene lacustrine rocks near Rome, Malheur County, Oregon, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D69-D74, illus., table, 1969.

Fluorite occurs as submicroscopic, nearly spherical grains in tuff, tuffaceous mudstone, and mudstone of an unnamed lacustrine deposit in southeastern Oregon. The fluorite is nonuniformly distributed in the upper 60 feet of the deposit. The content of fluorite is generally less than 5 percent, but it is as much as 16 percent in the lower part of a conspicuous zeolitic tuff. Fluorite probably formed during diagenesis in sediments that had been deposited in an alkaline, saline lake. — Authors' abstract

00182 **Sherwin, Jo-Ann.** Wavelength of folds in the Allegheny plateau [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 36, 1970.

07489 **Shideler, Gerald L.** The Johns Valley boulders in the late Paleozoic Ouachita facies, a product of wildflysch sedimentation [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 205, 1969.

**Shuart, Susan G.** *See* Ratcliffe, Nicholas M. 00176

**Siegel, Frederic R.** *See* Vaz, J. Eduardo. 07531

07490 **Siemers, Charles T.; Dodd, J. Robert.** Buried karst topography in the Florida Keys and its influence on Recent sedimentation and biotic distribution [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 205-206, 1969.

00077 **Signor, D. C.; Growitz, D. J.; Kam, William.** Annotated bibliography on artificial recharge of ground water, 1955-67: U.S. Geol. Survey Water-Supply Paper 1990, 141, p., 1970.

This sequel to Water Supply Paper 1477 by D. K. Todd (1959) emphasizes technology; however, annotations of articles on waste-water reclamation, ground-water management and ground-water basin management are included. Subjects closely related to artificial recharge, including colloidal flow through porous media, field or laboratory instrumentation, and waste disposal by deep well injection are included where they relate specifically to potential recharge problems. Citations are arranged alphabetically by author with additional author and subject-geographic indexes. — MCM

**Silberling, N. J.** *See* Armstrong, Augustus K. 07722

07491 **Silberman, M. L.; Hopkins, D. M.** Relict glacial sediments on the Bering shelf [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 206, 1969.

07492 **Silver, Eli A.** Tectonic implications of the structure of the Gorda Escarpment and of the magnetic anomaly pattern north of the escarpment [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 206-207, 1969.

07092 **Simmons, Gene; Roy, Robert F.** Heat flow in North America, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 78-81, illus., 1969.

The principal factors responsible for regional heat flow are due to energy released by the decay of radioactive elements and injection of hot material in various parts of the upper mantle in the geologic past. Extrapolation of available measurements on the basis of geologic and geophysical data reveals a broad pattern consisting of an eastern and a western province. The former is a relatively uniform heat-flow field whose anomalies are associated with concentrations of radioactivity in near-surface rocks. The western province is characterized by high values, probably originating in the mantle. — MS

07493 **Simmons, Marvin D.** Utilization of piezometers in remedial grouting Wolf Creek Dam [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 207, 1969.

**Simoneit, Bernd R.** *See* Burlingame, A. L. 07209

07069 **Simonen, Ahti.** Batholiths and their orogenic setting, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 483-489, illus., 1969.

The origin and emplacement of granitic batholiths are closely associated with tectonic activity in orogenic belts and with temperature variations resulting from interactions between the crust and mantle at the base of belts of folding. The parent magma was probably granodioritic in composition rather than the product of dif-

ferentiation of a basaltic magma, and was emplaced mainly by forceful injection. — MS

**Simons, P. Y.** *See* Dachille, Frank. 07205

07662 **Simpson, George Gaylord.** The present status of the theory of evolution: Royal Soc. Victoria Proc., new ser., v. 82, pt. 2, p. 149-160, 1969.

Darwin, in proposing his theory of evolution left some aspects of it unclearly developed, such as: the concept of varieties; origin of species in the modern sense of speciation; relationship of evolution in action to the origin of natural species; elucidation of evolutionary theory by the factual history of life; correct identification of the sources of organic variation and the nature of heredity, without which the concept of natural selection could not be fully developed. Progress in clarifying these points is discussed in the context of modern knowledge of heredity, based on the recently developed gene theory. The process of natural selection, involving organism-environment feedback, is the factor of orientation in evolution. It brakes the rate of change by eliminating extreme variants and favoring those nearer the population mode; examples of long, slow trends are common in the fossil record. — VMJ

07494 **Sims, Darrell L.** Drilling operations — The Deep Sea Drilling Project [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 207-208, 1969.

**Sinha, A. K.** *See* Tilton, G. R. 07523

00129 **Skinner, Brian J.** A sulfur lava flow on Mauna Loa: Pacific Sci., v. 24, no. 1, p. 144-145, table, 1970.

The only examples of observed sulfur magmas recorded in literature are one penetrated by a bore hole on White Island, New Zealand, and sulfur lava eruptions from a volcano on Hakkaido, Japan. Sulfur found in places in the Andean chain may have originated as lavas. This paper records a new occurrence at Sulphur Cone, Mauna Loa, Hawaii, a pyroclastic cone marking the site of a prehistoric eruption. Sulfur bloom covering it, for which it was named, is now gone. In 1967, a flow sheet of solid sulfur was observed on a west slope; the lower end was truncated by fissures of the 1950 Mauna Loa flank eruption. Fumarolic action is still intense along the fissures and has ablated and degraded much of the sulfur. The flow probably originated by the remobilization of previously deposited sulfur sublimate within the cone due to heating by events of the 1950 eruption. — ESL

**Skinner, Brian J.** *See* Metsger, Robert W. 07682

**Smith, A. R.** *See* Dodge, F. C. W. 07566

**Smith, A. Y.** *See* Little, H. W. 07664

**Smith, Avery E.** *See* Johnson, William D., Jr. 07220

07639 **Smith, Bennett L.** A comparison of percussion drilled and diamond drilled borings in grouting the upper reservoir of the Yards Creek hydroelectric pumped storage project, northern New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 208, 1969.

07495 **Smith, George I.; Matsuo, Sadao; Friedman, Irving.** Salt crystallization temperatures in Searles Lake, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 208-209, 1969.

00124 **Smith, Harriet W.** Guide to geological literature: Jour. Geol. Education, v. 18, no. 1, p. 13-25, illus., table, 1970.

The proliferation of geological literature and the demands of research geologists for comprehensive information about it have forced publishers of bibliographies to adapt computer techniques to their systems of indexing and preparation. Indexing systems,

most of which now are based on the use of key terms, include the KWIC, coordinate and key-alpha indexes, as well as the more traditional indexes. Some of the important comprehensive bibliographies available to geologists are listed in this paper. A knowledge of the organization of libraries, and of the services offered by libraries can assure that the research worker will derive the most benefit from this valuable asset. — Author's abstract

07342 **Smith, Hugh Preston.** The Thaynes Formation of the Moenkopi Group, north-central Utah [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2258B-2259B, 1969.

00214 **Smith, James G.; MacKevett, E. M., Jr.** The Skolai Group in the McCarthy B-4, C-4, and C-5 quadrangles, Wrangell Mountains, Alaska: U.S. Geol. Survey Bull. 1274-Q, p. Q1-Q26, illus., tables, geol. map, 1970.

The Skolai Group, believed Early Permian and here named, is a thick sequence of lava flows and overlying volcaniclastic and sedimentary rocks. It is divided into the older Station Creek Formation, containing a volcanic flow- and an overlying volcaniclastic-member; and the Hasen Creek Formation, mainly chert, shale, sandstone and limestone. No exposure of the groups base was found. Youngest-known regionally-subjacent rocks locally contain Mississippian fossils and are more deformed and metamorphosed than Skolai rocks which are overlain locally by fossiliferous Middle Triassic rocks probably with slight unconformity, and overlain extensively by Nikolai Greenstone or Tertiary rocks, with angular unconformity. No fossils were found in the Station Creek, but Early Permian fossils are abundant in overlying Golden Horn Limestone Lentil of the Hasen Creek. — *from* Authors' abstract

07496 **Smith, Kenneth G.; Blackburn, William H.** Chemical equilibrium in some metamorphosed iron-rich sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 209, 1969.

**Smith, S. M.** *See* Chase, C. G. 00209

07358 **Smith, Stewart W.; Archambeau, Charles B.; Gile, William.** Transient and residual strains from large underground explosions: Seismol. Soc. America Bull., v. 59, no. 6, p. 2185-2196, illus., table, 1969.

Tectonic strain readjustments associated with large underground explosions have been observed at the Nevada Test Site. The BENHAM event produced a peak quasi-static radial strain of $1.2 \times 10^{-7}$, 29 km away. This strain transient was followed by an exponential return to the initial state with a time constant of 13 min, and is interpreted as the direct elastic response of the medium to a time varying pressure in the BENHAM cavity. An upper bound on the tectonic strain release was set at $0.7 \times 10^{-8}$. It is estimated that the permanent and quasi-static strains associated with this explosion could significantly effect local earthquake occurrences out to distances of about 15 km. The size distribution of aftershocks of this explosion resembles that seen in model experiments of brittle fracture, in which distribution is controlled by the dimensions of inhomogeneities in the medium. — *from* Authors' abstract

**Smith, Stuart M.** *See* Johnson, David A. 07390

**Smithers, B. C.** *See* Jonson, David C. 07394

07225 **Smyth, Pauline.** (compiler). Bibliography of Ohio geology, 1961-1965: Ohio Div. Geol. Survey Inf. Circ. 36, 46 p., illus., 1969.

This serves as a supplement to previous bibliographies of Ohio geology: 1819-1950, Ohio Div. Geol. Survey Bull. 52, Watkins, 1953; 1951-60, ibid., Inf. Circ. 32, Smyth, 1963. Citations include unpublished theses, dissertations, and abstracts. The index contains subject entries and areal entries which are based on county. — MCM

07204 **Snetsinger, Kenneth G.; Keller, W. D.** Differential thermal analysis of high-alumina allophane: Am. Mineralogist, v. 54, nos. 9-10, p. 1469-1470, illus., 1969.

A differential thermalgram of high-alumina allophane ($SiO_2 2Al_2O_3 8H_2O$) shows an endothermal peak at 90°C representing loss of water; there is no evidence of $OH^-$. Amounts of fluxing ions were apparently insufficient to suppress a high-temperature exothermal reaction at 990°C, tentatively ascribed to formation of an Al-Si spinel. — Authors' abstract

00194 **Snow, D. T.** The frequency and apertures of fractures in rock: Internat. Jour. Rock Mechanics and Mining Sci., v. 7, no. 1, p. 23-40, illus., tables, 1970.

Pressure-test data have been used to estimate average spacing and aperture of water-conducting fractures in undisturbed rocks. Discharges from packer injection tests show skewed distributions, each a compound of distribution of numbers of fractures intersected by drillholes in intervals between packers, and distribution of fracture apertures. Numbers are approximately Poisson-distributed in structurally-uniform rock; thus, mean and variance of fracture frequency can be estimated from frequency of intersecting non water-conducting fractures, which is the observed frequency of zero-discharges. Then, mean aperture and standard deviation of apertures of equivalent parallel-plate openings can be computed from parameters of discharge distribution. If the lognormal distribution, observed on surface outcrops, prevails in undisturbed rocks, then mean and standard deviation computed from water tests may disclose fracture sizes at any specified depth. — *from* Author's abstract

07759 **Sohn, I. G.** Nonmarine ostracodes of Early Cretaceous age from Pine Valley quadrangle, Nevada: U.S. Geol. Survey Prof. Paper 643-B, p. B1-B9, illus., 1969.

Nonmarine *Cypridea* (*Cypridea*) *pecki* n. sp. and *C.* (*Bisulcocypridea*) *bicostata* n. subgen., n. sp. are described from Nevada. *C.* (*C.*) *pecki*, associated in Nevada with *"Paracypridea"* sp. and *Petrobrasia*, sp. was recorded from the Draney Limestone (upper Aptian) of Idaho-Wyoming as *C. diminuta* Vanderpool, 1928. Its presence indicates that the age of the rocks in Nevada is late Aptian. *C.* (*C.*) *lubimovae* new name is proposed for *C. spinigera* Lubimova, 1956, not *C. spinigera* (Sowerby), 1836. — Author's abstract

07497 **Sommer, Sheldon E.** Cathodoluminescence of $Mn^{+2}$-activated carbonates [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 209-210, 1969.

07498 **Sorauf, James E.** Microstructure and formation of dissepiments in Recent Scleractinia [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 210, 1969.

00183 **Soren, Julian.** The Port Jervis thrust fault, Tri-States area, New York, New Jersey, and Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 36-37, 1970.

07109 **Sörensen, Henning.** Rhythmic igneous layering in peralkaline intrusions—An essay review on Ilímaussaq (Greenland) and Lovozero (Kola, USSR): Lithos, v. 2, no. 3, p. 261-283, illus., tables, 1969; *reprinted as* Grönlands Geol. Undersögelse Misc. Paper 67, 1969.

The Ilímaussaq and Lovozero peralkaline intrusions both contain layered nepheline syenites made up of rhythmically repeated units composed of three layers. The lower contact of each unit is abrupt. In Ilímaussaq, each unit displays mineral-grading with a lower black (arfvedsonite, aegirine), an intermediate red (eudialyte) and an upper white layer (alkali feldspar). In Lovozero the three-layer units are from the bottom urtite, foyaite and lujavrite. It is suggested that mineral-grading is caused by differential settling of minerals nucleated in a certain interval of consolidation, and recurrence of layered units by intermittent crystallization of volatile-rich peralkaline magmas. — Author's abstract

**Soutar, Andrew.** *See* Berger, Wolfgang H. 00085

**Spadaro, Anthony R.** *See* Hickman, G. Daniel. 07139

07499 **Spang, John H.; Chapple, William M.** Twinning strain measurements from a naturally folded limestone [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 210-211, 1969.

07352 **Spangler, Daniel Patrick.** A geophysical study of the hydrogeology of the Walnut Gulch experimental watershed, Tombstone, Arizona [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2264B, 1969.

07343 **Spearing, Darwin Robert.** Stratigraphy, sedimentation and tectonic history of the Paleocene-Eocene Hoback Formation of western Wyoming [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2259B, 1969.

07500 **Speed, Robert C.** Metasomatic albite, talc, and chlorite in quartz sandstone, western Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 211, 1969.

07582 **Speidel, David H.** Phase transitions in the mantle — Lower limit of the asthenosphere [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 294-295, illus., 1969.

07631 **Spencer, D. W.; Manheim, F. T.** Ash content and composition of Millipore HA filters, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D288-D290, tables, 1969.

Analyzed Millipore HA brand of micropore filters contained about 0.04 percent ash. The main constituents of the ash were Na, Ca, Si, Mg, K, and P. More than 1 percent Fe, Cu, Cr, Zn, and Al oxides were also present; these may influence analysis of suspended detritus in sea water. — Authors' abstract

00087 **Spencer, R. S.; Rogers, W. S.** Reworked Paleozoic fossils in Pleistocene sediments of southeastern Virginia: Geol. Soc. America Bull., v. 81, no. 1, p. 263-265, illus., 1970.

Paleontologic and lithologic analysis of several gravel zones within the Nansemond Formation provides new information for the interpretation of the geomorphic and paleogeographic history of the James River drainage basin. A basal gravel zone, containing pebbles and cobbles of rock characteristic of the Blue Ridge and Piedmont, suggests that the James River had not extended its drainage basin beyond this area by the beginning of Nansemond time. An upper gravel zone, containing fossiliferous chert and limestone fragments predominantly of Devonian age, suggests that the James River system did not reach the Devonian source area in the Valley and Ridge Province until late Nansemond time. — Authors' abstract

07501 **Spigai, J. J.; Kulm, L. D.** Patterns of Holocene sedimentation on the continental slope off southern Oregon [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 212, 1969.

07178 **Stacey, Frank D.** Physics of the Earth: New York and London, John Wiley and Sons, 324 p., illus., tables, 1969.

The main purpose of this text is to present the fundamental problems in solid-earth geophysics for graduate and advanced undergraduate studies of physics. Mathematical developments are simplified or relegated to appendices to make most of the material understood by students of geology and related sciences. Paleomagnetism is presented as a central theme. Chapter headings are: solar system, rotation and the figure of the Earth, gravity field, seismology and internal structure of the Earth, geomagnetic field, paleomagnetism, creep and anelasticity of the mantle, radioactivity and age of the Earth, and Earth's internal heat. The bibliography comprises 19 pages; author and subject indexes are appended. — MCM

07502 **Staley, Richard M.** Individualized instruction in earth science topics [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 212-213, 1969.

07503 **Stallman, R. W.; Weeks, E. P.** The use of atmospherically induced gas-pressure fluctuations for computing hydraulic conductivity of the unsaturated zone [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 213, 1969.

00184 **Stanley, E. A.** Stratigraphical and geographical distribution of the fossil pollen group Tripojectacites (*Aquilapollenites* and closely related forms) [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 37, 1970.

**Stanley, Rolfe S.** *See* Hatch, Norman L. 00161

07504 **Stanton, Robert J., Jr.** Cyclic Tertiary shallow marine sedimentation, California [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 214, 1969.

**Stateham, Raymond M.** *See* Wisecarver, David W. 07164

07727 **Steele, Forrest; Daniels, R. B.; Gamble, E. E.; Nelson, L. A.** Fragipan horizons and Be masses in the middle Coastal Plain of north central North Carolina: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 752-755, illus., tables, 1969.

Soils with fragipan horizons are minor in areal extent but soils with friable eluviated (Be) masses are common along the 120- and 140-foot contours (37- to 43-m) of the Sunderland geomorphic surface between Goldsboro, N. C., and Emporia, Va. Where they occur, fragipan horizons commonly have Be masses, and in some the dense brittle materials and friable eluviated materials are intimately mixed. The morphology of fragipan horizons and horizons with Be masses are similar and it is difficult to separate them where they merge on the landscape. Brittleness is about the only feature that can be used consistently to separate fragipan horizons and horizons with Be masses. Brittleness that is produced by partial iron cementation, plinthite for example, should not be used in identification of fragipan horizons. — Authors' abstract

07505 **Stehli, Francis G.** How reliable is biostratigraphy? [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 214-215, 1969.

**Stehman, Charles F.** *See* Lynts, George W. 07575

07506 **Steller, David D.; Hodder, David T.** Geologic interpretation of the Casa Diablo geothermal area, California, using remote sensors [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 215, 1969.

**Stephens, J. C.** *See* McDowell, L. L. 07644

07107 **Steraberg, Richard W.; Creager, Joe S.** Coasts — A primer: Oceans, v. 2, nos. 3-4, p. 36-46, illus., 1969.

The coastal environment studies offered by Department of Oceanography of the University of Washington for college and high school classes and groups of citizens are described. A three-week noncredit course, "Coasts of the World", held in the South Pacific area, will be continued, studying different coasts of the world. Coastal environment is unique; air, water, and solid earth meet in one zone where geologic, biologic, meteorologic, and oceanographic processes interact. These realms of influence are discussed individually. The geologic influence is opposed to the ocean's, as in deltas, glaciers, volcanoes, and lithology. Reefs are the prime examples of the biologic influence; vegetation also stabilizes beaches. A classification scheme for coasts proposed by F. P. Shepard is given. — ESL

**Steven, Thomas A.** *See* Lipman, Peter W. 07606

07099 **Stevens, Anne E.** Worldwide earthquake mechanism, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 153-160, illus., tables, 1969.

Data on the mechanism of energy release at the focus of an earthquake are reviewed and two focal models are derived on the basis of analysis of earthquakes whose mechanism solutions with shear and surface waves have been calculated from apparently relatively reliable data. — MS

07507 **Stevens, R. K.; Church, W. R.; Saint Julien, P.** Age of ultramafic rocks in the northwestern Appalachians [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 215-216, 1969.

07508 **Stevenson, Robert E.; Uchupi, Elazar.** The dispersion of suspended sediments off southeastern United States, as viewed from manned space craft [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 216, 1969.

**Stewart, E. H.** *See* McDowell, L. L. 07644

07509 **Stindl, H.** Bulk chemical analysis of rock sections using the electron probe [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 216-217, 1969.

07232 **Stith, David A.** Potential use of Ohio limestones and dolomites for architectural aggregate: Ohio Div. Geol. Survey Rept. Inv. 73, 14 p., illus., tables, 1969.

Aggregate material used for wall facings and terrazzo ranges from sand to cobbles and flagstones. Results of a literature search for the physical requirements are given, and 20 samples collected from selected quarries were tested for absorption, soundness, and hardness. Texture, color, and impurities were determined by physical and microscopic examination; results are summarized in a table. Guelph Dolomite and Niagara Limestone should be good sources, the Cedarville Dolomite has only marginal hardness, and the Columbus and Brassfield Formations have good color but were not sound at the locations sampled. — ESL

**Stober, Manfred.** *See* Seckel, Hansjörg. 07258

07510 **Stone, George Thomas.** Preliminary petrologic appraisal of Craters of the Moon, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 217, 1969.

07511 **Stone, George Thomas.** Structural implications of Quaternary lava-dome distribution in the Snake River Plain, Idaho [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 217-218, 1969.

07661 **Stone, J. Fred.** Palynology of the Eddleman Coal (Pennsylvanian) of north-central Texas: Texas Univ. Bur. Econ. Geology Rept. Inv. 64, 55 p., illus., tables, 1969.

The Eddleman Coal (Thrifty Formation, Cisco Group) at two localities in Young County, Tex., has yielded a spore and pollen flora of 37 genera and 65 species, including *Duplicatotriletes heueri* n.gen., n.sp., and 10 new species in existing genera. The flora is dominated in number of taxa by trilete spores. The Eddleman Coal at the type locality is divisible into a lower and an upper portion, the latter distinguished by increased abundance of the monosaccate genus *Florinites*. Comparison with the microflora of the McLeansboro Group in the Illinois Basin substantiates the Virgilian age of the Eddleman Coal. It contains 11 genera and 20 species in common with those described by Kosanke (1950) and 22 genera and 18 species in common with those described by Peppers (1964); 4 species have been reported previously only from the upper McLeansboro. — VMJ

07251 **Strahl, E. O.** Multiple regression matrix corrections for X-ray spectrographic analysis [abs.]: Appl. Spectroscopy, v. 23, no. 6, p. 671, 1969.

07123 **Strange, W. E.; Woollard, G. P.** The use of geologic and geophysical parameters in the evaluation, interpolation, and prediction of gravity: Hawaii Inst. Geophysics [Rept.] HIG-64-17, [209] p., illus., tables, 1969; originally published 1964.

This work demonstrates the physical accountability of gravity by establishing relations between variations in the observed gravitational field within continental United States and variations in observable geologic and geophysical parameters. The first four sections (method of procedure, regional relations, residual relations, detailed study) give examples of correlations between gravity anomalies and geologic and geophysical parameters to show methods by which correlations can be used for evaluation, interpolation, and prediction. Observed gravity is the result of actual den-

sity distribution of the Earth, each part of which affects the gravity field, and in some cases geologic information can be translated directly into density information; an example of this procedure was used in Wyoming where Cenozoic sediment densities are well known and basement rock densities can be estimated. In other cases empirical correlations must be established. — VSN

**Streeter, S. Stephen.** *See* Buchanan, Hugh. 00144

**Strimple, Harrell L.** *See* Moore, Raymond C. 07738

07111 **Stringfield, V. T.; LeGrand, H. E.** Relation of sea water to fresh water in carbonate rocks in coastal areas, with special reference to Florida, U.S.A., and Cephalonia (Kephallinia), Greece: Jour. Hydrology, v. 9, no. 4, p. 387-404, illus., 1969.

Under certain equilibrium conditions of fresh and salt water in some carbonate aquifers, unusual hydrologic phenomena exist. Hydrologic conditions at Tarpon Springs, Florida, and Cephalonia, Greece, include deep vertical openings as sinkholes through a relatively impervious part of the aquifer system. In both cases tops of sinkholes or natural wells are exposed to sea water. At Tarpon Springs, Fla., dynamic equilibrium between salt and fresh waters fluctuates so that flow of salt water from the spring to a lake two miles away is sometimes reversed. Both cases represent a partially confined U-tube system where water at the seaward, sinkhole end is denser than at the other end, and where a low fresh-water head is less than the salt-water head. — *from* Authors' abstract

**Stuart-Alexander, Desiree E.** *See* Naeser, C. W. 07692

**Stuiver, Minze.** *See* Denton, George H. 07361

07512 **Stuiver, Minze; Armstrong, Richard L.; Denton, George H.** Quaternary glacial chronology, White River Valley, northern Wrangell and St. Elias Mountains, Alaska [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 218, 1969.

07513 **Sturm, Edward.** The delineation of paleocurrent basins by the analysis of differences of moving averages [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 219, 1969.

07514 **Subbarao, K. V.; Ferguson, R. B.; Turnock, A. C.** Optical and microprobe analyses of zoned plagioclases [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 219, 1969.

00218 **Summerson, C. H.; Swann, D. H.** Patterns of Devonian sand on the North American craton and their interpretation: Geol. Soc. America Bull., v. 81, no. 2, p. 469-490, illus., 1970.

Quartz sand of fine to medium size, well sorted, rounded, and frosted is common and widespread in many units of early and middle Paleozoic age in the central part of North America. A detailed study of its distribution shows that, except as cavity fillings, sand is not present in the Middle and Upper Silurian (Niagaran and Cayugan) or in Devonian rocks equivalent to or older than the Camden and Clear Creek Cherts. Characteristically, sand occurs in varying concentrations in Middle Devonian rocks immediately overlying the erosion surface that truncates Silurian and Lower Devonian (Clear Creek and earlier) strata. It also occurs in shoreline concentrations marking subsequent retreats and advances of the Devonian sea and in the extent of each onlap over the older rocks. The patterns of distribution identify the sources of the sand and aid in interpreting the behavior of a part of the North American craton during much of Devonian time. — *from* Authors' abstract

07195 **Sunderman, Jack A.; Beck, Carl W.** Hydrobasaluminite from Shoals, Indiana: Am. Mineralogist, v. 54, nos. 9-10, p. 1363-1373, illus., table, 1969.

Hydrobasaluminite is found as irregular patches and lenses in allophane and halloysite at the Mississippian-Pennsylvanian unconformity. The clay mineral deposits

are underlain by Glen Dean Limestone. The hydrobasaluminite formed by alteration of allophane replacing the Glen Dean, or by direct replacement. X-ray investigation shows that this hydrobasaluminite is identical to that reported from England, France, Kansas, and other places. It dehydrates to basaluminite at room temperature, dehydrates further to metabasaluminite at 100°C, and decomposes to amorphous material at 200°C. Poorly crystalline alumina forms between 940°C and 1000°C. Chemical analyses suggest the formulas $Al_4SO_4(OH)_{10}12H_2O$ for hydrobasaluminite, $Al_4SO_4(OH)_{10}5H_2O$ for basaluminite, and $Al_4SO_4(OH)_{10}H_2O$ for metabasaluminite. —*from* Authors' abstract

07169 **Sutton, Ann; Sutton, Myron.** The American west — A natural history: New York, Random House, 270 p., illus. [1969,].

To review the transformation of the American West from past to future, this book uses chiefly geology and ecology. Section headings are: sun, sand, and saguaros — the hospitable desert; southwestern plateaus; hundred worlds of the Grand Canyon; enchanted circle — Four Corners country; lesser known places of the canyonlands; high peaks and fossil beds — Southern Rockies; wilderness of wonders — Middle Rockies; secrets of the Basin and Range province; treasures of the High Sierra — John Muir's range of light; of forest and sea — exploring the Pacific Coast; volcano country — north to the Cascades; hidden trails in the Northern Rockies; badlands; in the wilds of western Canada; by fiord to Alaska, nature's last frontier; and prospects for nature in the west. A 52-item bibliography and an index are appended. — MCM

**Sutton, Myron.** *See* Sutton, Ann. 07169

07750 **Swain, Frederick M.; Bratt, Judy M.; Kirkwood, Samuel; Tobback, Paul.** Carbohydrate components of Paleozoic plants, *in* Advances in organic geochemistry 1968 — Internat. Mtg., 4th, Amsterdam, 1968, Proc.: Oxford, England, and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 31), p. 167-180, illus., tables, 1969.

Plant fossils of 25 Devonian-Permian species have yielded small but reasonably consistent carbohydrate residues by extraction and chromatographic and enzymatic analysis, providing a basis for comparison with younger representatives. The presence of linear $\alpha$- and $\beta$-1.→4 linked glucopyranose units of the nature of starch and cellulose are indicated. Preheating of rock samples seems to increase yields of sugars, owing to disseminated organic matter protected by mineral grains; preheated plant fossil specimens had spotty results in carbohydrate yield. Activation energy of glucose in aqueous solution ranges in Kcal per mole from about 21.2 for glucose + montmorillonite to 25 for glucose and Devonian shale; the value for glucose alone is about 22 Kcal per mole. — GDC

**Swann, D. H.** *See* Summerson, C. H. 00218

**Swift, C. M., Jr.** *See* Madden, T. R. 07067

**Swift, Robert N.** *See* Oostdam, B. L. 00173

**Swindale, L. D.** *See* Lai, Sung-ho. 07648

00185 **Swinehart, James B.; Williams, Eugene G.** Influence of paleotopography on the continental and marine cycles of the lowest Conemaugh and Allegheny, western Pennsylvania [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 38-39, 1970.

**Syers, J. K.** *See* Roth, C. B. 07263

07098 **Sykes, Lynn R.** Seismicity of the mid-oceanic ridge system, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 148-153, illus., 1969.

Earthquakes occur within single narrow linear zones of the oceanic part of the ridge system and over wider areas in continental parts of the system. They consist of shallow-focus earthquakes; earthquakes of intermediate or deep focus have not been recorded. The distribution pattern, mechanism solutions, and other geophysical data indicate that the ridge system is characterized by transform faults and sea-floor spreading, as well as other effects of crustal extension. — MS

07368 **Szalay, Frederick S.** Origin and evolution of function of the mesonychid condylarth feeding mechanism: Evolution, v. 23, no. 4, p. 703-720, illus., 1969.

Evolutionary trends of the mesonychid feeding mechanism are traced from the Late Cretaceous primitive arctocyonid condylarth *Protungulatum*, through early Paleocene triisodontine arctocyonids such as *Eoconodon*, to the early mesonychids such as the middle Paleocene *Dissacus*. Although all other condylarth lines evolved into medium- and large-size herbivores, only a carnivorous mode of life can explain morphological adaptations of the dentition, skull, and mandible in the early mesonychids. The lower teeth became transversely compressed and developed analogs of carnassial notches; in the upper molars the parastyle andd metastyle areas were enlarged, with loss of paraconules and metaconules. The power of the temporalis and internal pterygoid muscles was greatly increased and the articular condyle evolved into a robust hinge-type joint. These changes facilitated grasping and tearing meat and crushing bone. — VMJ

00186 **Szucs, F. K.** Pre-Pleistocene drainages of Slippery Rock and Muddy Creeks determined by subsurface exploration [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 39, 1970.

**Takeuchi, Y.** *See* Nowacki, W. 07704

07079 **Talwani, Manik; LePichon, Xavier.** Gravity field over the Atlantic Ocean, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 341-351, illus., 1969.

Values obtained by averaging surface ship and submarine pendulum gravity data indicate that a significant part of the anomalies cannot be attributed to topography and its isostatic compensation. Analysis of the data suggests that an isostatic mechanism operates to great depths in the upper mantle and that there are lateral inhomogeneities in the upper mantle that are nonisostatic in character. — MS

**Talwani, Manik.** *See* Rabinowitz, Philip D. 07459

**Tanner, W. F.** *See* Osmond, J. K. 00089

07516 **Tanner, William F.** Ripple mark variability [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 220, 1969.

07241 **Taylor, F. C.** Geology of the Annapolis-St. Marys Bay map-area, Nova Scotia (21A, 21B east half) [with French abs.]: Canada Geol. Survey Mem. 358, 65 p., illus., tables, geol. maps, 1969.

In southwestern Nova Scotia, Ordovician and older greywacke and slate of the Meguma Group form the Goldenville and Halifax Formations; above them in western parts, the sedimentary and volcanic White Rock Formation (Ordovician-Silurian) is overlain by the Kentville and, near the north boundary, New Canaan Formation, and in Digby and Nictaux-Torbrook districts by fossiliferous Torbrook Formation (Devonian); intrusions are granitic batholiths and local basic rocks. Unconformably overlying older rocks in the northeast, are Mississippian strata of Horton and Windsor Groups, and in the northwest, Triassic sedimentary and volcanic rocks. Pleistocene drift and proglacial deposits are extensive. Early Paleozoic rocks are metamorphosed to two regional facies, locally by contact, and are folded; faults are chiefly post-Mississippian, pre- and post-Triassic. Mineral products are chiefly anhydrite and gypsum. — GDC

**Taylor, Hugh P., Jr.** *See* Wenner, David B. 07539

07517 **Taylor, Lawrence A.** Low-temperature iron sulfides [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 221, 1969.

07364 **Taylor, S. R.; Kaye, Maureen; White, A. J. R.; Duncan, A. R.; Ewart, A.** Genetic significance of V and Ni content of andesites — Reply to Prof. E. F. Osborn [1969]: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1555-1557, 1969.

The similarity in the vanadium content of basalts and orogenic andesites restricts the amount of vanadium-bearing minerals which can be removed during fractional crystallization processes, if orogenic andesites are derived from parent material of basaltic composition. These problems are discussed in the light of comments by Prof. Osborn [ibid., p. 1553-1554]. — Authors' abstract

07518 **Thayer, T. P.** A quest for podiform chromitite in Precambrian rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 222, 1969.

07519 **Theis, C. V.** Reconstruction of ground-water conditions on the Llano Estacado in Ogallala time [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 222, 1969.

07520 **Thode, H. G.** The sulphur isotope geochemistry of sulphides and related minerals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 223, 1969.

07521 **Thomas, William A.** Appalachian-Ouachita structural salients and clastic wedges — Common genesis, [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 223-224, 1969.

07522 **Thompson, Allan M.** Paleoenvironments and mechanics of color origin, Upper Ordovician of southern Appalachian Valley and Ridge [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 224, 1969.

**Thompson, C. J.** *See* Tolmie, R. W. 07672

**Thompson, J. B., Jr.** *See* Waldbaum, D. R. 07187

07262 **Thyssen, F.** Professor Dr. Bernhard Brockamp [1902-1968]: Polarforschung 1968, v. 38, pt. 6, nos. 1-2, p. 188-190 [1969].

**Tiefel, Carol F.** *See* Cleveland, John H. 07152

07194 **Tien, Pei-lin; Waugh, Truman C.** Thermal and X-ray studies on earthy vivianite in Graneros Shale (Upper Cretaceous), Kansas: Am. Mineralogist, v. 54, nos. 9-10, p. 1355-1362, illus., tables, 1969.

Samples of earthy vivianite were treated thermally at different temperatures. The intensity of the peaks on their X-ray diffractometer patterns decreases with increasing temperature up to 300°C. Vivianite becomes amorphous after heating to 300°C. A poorly crystalline material is developed between 500°C and 625°C. Above 650°C, a mixture of iron (III) orthophosphate ($FePo_4$) and an unknown compound is formed. A reversible polymorphous transformation takes place between 675°C and 750°C. Infrared studies indicate that vivianite may contain hydroxyl ions, and favor the structural formula of $Fe_{3-x}^{2+}Fe_x^{3+}(PO_4)_2$ [$(8x)H_2Ox(OH)$] for vivianite rather than the conventional formula of $Fe_3(PO_4)_28H_2O$. — Authors' abstract

**Tilling, R. I.** *See* Gottfried, David. 07572

07523 **Tilton, G. R.; Sinha, A. K.** Age of the least radiogenic terrestrial leads [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 224-225, 1969.

07524 **Ting, Francis T. C.** Classification of coal by rank — A petrographic approach [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 225, 1969.

00109 **Tinkler, Keith J.** Pools, riffles and meanders: Geol. Soc. America Bull., v. 81, no. 2, p. 547-552, illus., 1970.

The conventional view of pools and riffles in straight channels being identified with bends and inflections in meander trains is challenged; the alternative identification, pools and riffles inflections and bends is argued. Difficulties inherent in the conventional view are outlined and it is shown that the alternative is consistent with Bagnold's idea of "breakaways" when the radius of curvature is in the region of 2-3. The conflict could be resolved by experimental observation. — Author's abstract

**Tobback, Paul.** *See* Swain, Frederick M. 07750

**Tobisch, Othmar T.** *See* McIntyre, David H. 00131

07640 **Tobisch, Othmar T.; Fleuty, Michael J.** Use of geographic names for successive fold phases in areas of multiple folding [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 225-226, 1969.

00128 **Tocher, Don.** [Discussion of a chart comparing energies in earthquakes and explosions, 1969]: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 1, p. 16-17, illus., 1970.

A more meaningful comparison would result from equating the magnitude determined from seismic waves recorded from an explosion of a given amount of TNT, as only a small fraction of the "chemical" energy in an underground explosion is propagated outward in seismic waves. Some examples in the literature are compared with the chart (ibid., v. 22, no. 5, 1969) to prove that most of the energy is dissipated in other ways — crushing, melting, etc. — ESL

07672 **Tolmie, R. W.; Thompson, C. J.** Field equipment for neutron activation analysis, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 489-505, illus., tables, discussion, 1969.

Neutron activation analysis offers some appealing advantages for routine geochemical analyses. Sample preparation is simple, sensitivities are very good for many elements, several of which may be analyzed simultaneously, and the technique averages the concentration in a reasonably large sample. Neutron activation analysis equipment is now available compact enough to be transported to a base camp, and is easy to operate. Such a system is described comprising an Sb:Be neutron source with a pneumatic sample transport, a pair of scintillation counters in a 4-in. thick lead shield, a Ge-(Li-drift) detector and a small computer. Applications include ore assay, rock identification, and exploration based on trace-element contouring. Typical results from a variety of such applications are presented. — Authors' abstract

07280 **Tomlinson, Jack T.** The burrowing barnacles (Cirripedia: Order Acrothoracica): U.S. Natl. Mus. Bull. 296, 162 p., illus., tables, 1969.

Acrothoracicans are small (<8 mm) nonparasitic marine cirripeds with soft carapace lacking calcareous plates, that live in burrows abraded into usually dead molluscan or other shelly material or limestone. All known taxa, predominantly living forms, are systematically described herein; there are also sections on anatomy, functions, ecology, distribution, and phylogeny. Families are reduced to three: Lithoglyptidae (including 7 former families), Cryptophialidae, and Trypetesidae. Fossil burrows of Carboniferous to Tertiary age can be assigned to extant families. Eight named species include *Simonizapfes davenporti*, n.sp., Upper Cretaceous, Middletown, N.J.; *Rogerella cragini* Schlaudt and Young, 1960, Lower Cretaceous of Texas; *Trypetesa caveata* Tomlinson, 1963, Pennsylvanian-Permian of Kansas, Texas, Oklahoma. — VMJ

07239 **Toomey, Donald Francis.** The biota of the Pennsylvanian (Virgilian) Leavenworth Limestone, midcontinent region — Pt. 2, Distribution of algae: Jour. Paleontology, v. 43, no. 6, p. 1313-1330, illus., tables, 1969.

Thirteen algae and algal-related structures, all compared to previously described taxa, are reported from the Leavenworth Limestone: species of *Archaeolithophyllum*, *Foliophycus*, *Cuneiphycus*, *Epimastopora*, *Anchicodium*, *Eugonophyllum*, *Girvanella*,

*Tubiphytes*; algal-coated grains ("osagid"-type and *Archaeolithophyllum* crusts); and coarse and fine borings probably previously reported as *Girvanella*. Algae of one or more major groups (red, green, blue-green) occur as skeletal grains within the three Leavenworth facies at almost every locality, but are not abundant except for algal-coated grains, which on the basis of thin-section point counts average 10 percent of total rock volume. The algal flora probably lived in a shallow-water marine environment on a slowly subsiding platform. — *from* Author's abstract

**Totten, Stanley M.** *See* White, George W. 07659

**Tourtelot, Elizabeth B.** *See* Vine, James D. 07597

**Trantolo, A. P.** *See* Peterson, J. B. 07635

**Trask, N. J.** *See* Wilshire, H. G. 07643

07607 **Trask, Newell J.** Ultramafic xenoliths in basalt, Nye County, Nevada, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D43-D48, illus., table, 1969.

Lherzolites from ejecta and flows around two vents in central Nevada are moderately to strongly deformed; olivine-rich wehrlites and dunites are intensely deformed; and clinopyroxene-rich wehrlites, clinopyroxenites, and gabbros are undeformed to only slightly deformed. The olivine-rich wehrlites contain striking large, black, glassy clinopyroxene grains some of which are broken and invaded by fine-grained recrystallized olivine. The lherzolite probably came from the upper mantle; the clinopyroxene-rich wehrlite, and clinopyroxenite may have formed in the lower crust as cumulates from the magma that produced some nearby basalt flows older than the host rock; source of the highly deformed olivine-rich wehrlite and dunite is not clear. — Author's abstract

07119 **Trettin, H. P.** Geology of Ordovician to Pennsylvanian rocks, M'Clintock Inlet, north coast of Ellesmere Island, Canadian Arctic Archipelago [with French abs.]: Canada Geol. Survey Bull. 183, 93 p., illus., tables, geol. map, 1969.

A key area within the magmatic belt of the Franklinian Geosyncline is described and analyzed. Three major stratigraphic sequences separated by angular unconformities are exposed: a Middle Ordovician or older sequence, over 1,000 feet thick; a late Middle Ordovician to Late Silurian sequence, over 14,600 feet thick, assigned to seven formations, and deposited in non-marine to deep-sea environments; and a Middle Pennsylvanian and younger sequence, more than 4,400 feet thick, deposited in non-marine to shallow marine environments. Igneous intrusions differ widely in size, composition, and age. Southerly trending structures, continuous with the southeastern flank of Lomonosov Ridge characterize the northwestern part, and easterly trends, conforming with northern Ellesmere Island, are typical of the south half. The intersection of these trends, marked by a trough and ultrabasic intrusion, was repeatedly a site of crustal extension. — *from* Author's abstract

**Troxel, Bennie W.** *See* Wright, Lauren A. 07554

07525 **Trzcienski, Walter E., Jr.** Distribution of Mg and Fe between staurolite, biotite and chlorite from the Whetstone Lake area, Ontario [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 226-227, 1969.

07158 **Tschudy, Bernadine D.** Species of *Aquilapollenites* and *Fibulapollis* from two Upper Cretaceous localities in Alaska: U.S. Geol. Survey Prof. Paper 643-A, p. A1-A17, illus., tables, 1969.

Eight new species of *Aquilapollenites* from two Upper Cretaceous localities in Alaska are named and described. Three species of *Aquilapollenites*, also present in the samples at these localities, had been described previously from Cretaceous sedimentary rocks of Russia and Canada. These three species are present also in Upper Cretaceous rocks of the northern Rocky Mountains of the United States but none of

the eight new species of *Aquilapollenites* has been observed in samples from the Rocky Mountain region. One species of the genus *Fibulapollis* was found in the Alaskan samples, but it occurs only as rare specimens. This species is also present in some Upper Cretaceous samples from the Rocky Mountain region and is similar to two previously described species from Siberia. — BDT

**Turner, A. K.** *See* Davis, L. G. 07274

07526 **Turner, A. Keith; Melhorn, Wilton N.** Trend surface modeling of water-table geometries [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 227, 1969.

**Turner, Donald L.** *See* Yeats, Robert S. 07556

07356 **Turner, Gerry H.** Energy partition in high-velocity-impact cratering [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2348B, 1969.

**Turnock, A. C.** *See* Subbarao, K. V. 07514

**Uchupi, Elazar.** *See* Emery, K. O. 00099

00136 **Uchupi, Elazar.** Atlantic continental shelf and slope of the United States — Shallow structure: U.S. Geol. Survey Prof. Paper 529-I, p. I1-I44, illus., 1970.

Seismic surveys augmented by coring, drilling, and dredging operations have made possible reconstruction of formation of the continental terrace. The terrace north of Cape Hatteras, North Carolina, was formed by upbuilding and seaward progradation atop subsiding pre-Cretaceous rocks. South of Cape Hatteras it was formed by carbonate accretion along the seaward edge, and lagoonal deposition landward of the carbonate ridge. Fluvial, glacial, and marine erosion and deposition during the Pleistocene have modified this framework to some degree. — EU

**Uchupi, Elazar.** *See* Stevenson, Robert E. 07508

**Uchupi, Elazar.** *See* Oldale, R. N. 07706

07752 **U.S. Atomic Energy Commission.** Summary report on activities for assuring the safety of underground nuclear testing — U.S. Atomic Energy Comm. Rept. TID-24996: Washington, D.C., U.S. Govt. Printing Office, 20 p., illus., 1969.

Containment and venting are reasonably well understood. Ground-water conditions have been studied extensively for areas surrounding underground test locations. Gross characteristics of ground motion caused *directly* by underground nuclear explosions can be predicted with confidence based on yield, distance from the burst point and local conditions. Aftershocks, which often follow nuclear explosions, are generally limited to the vicinity of the burst point, but work will continue to be done in this area. Based upon considerations of experience and information, the chance of the proposed Amchitka tests generating a dangerous tsunami through a triggered earthquake appears to be negligible. — *from* Author's summary

07226 **U.S. Geological Survey.** Aeromagnetic map of the Libby and Mt. Pend Oreille quadrangles, Lincoln and Sanders Counties, Montana, and Bonner County, Idaho: U.S. Geol. Survey Geophys. Inv. Map GP-682, scale 1:62,500, 1969.

07602 **U.S. Geological Survey.** Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D1-D299, illus., tables, 1969.

This collection of 45 short papers (pertinent articles cited separately) is the third published chapter of Survey research for 1969 in the fields of petrology and petrography, mineralogy, economic geology, structural geology, stratigraphy, paleontology, geophysics, astrogeology, impact study, Pleistocene geology, paleogeomorphology, surface water, ground water, quality of water, sedimentation, geochemistry of water, dispersion and diffusion studies, hydrologic instrumentation, and topographic survey equipment. — MCM

07527 **Uthe, R. E.; Heimlich, R. A.** Geochemistry of the Hazelton Peak ortho-amphibolite, Bighorn Mountains, Wyoming [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 228, 1969.

**Uyeda, Seiya.** *See* Horai, Ki-iti. 07094

07084 **Vacquier, Victor.** Magnetic intensity field in the Pacific, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 422-430, illus., 1969.

Over much of the Pacific Ocean the magnetic field is smooth, but in certain areas sets of linear anomalies occur, hundreds of kilometers long and ranging in width from 5 to 50 km. Spreading submarine ridges may be responsible for the magnetic lineation. Paleomagnetic data indicate northward migration of seamounts since the late Cretaceous, but may also be interpreted as proof of polar wandering. North of the Mendocino fracture zone, off the west coast of North America, the abrupt disappearance of the lineated magnetic anomalies at the foot of the continental slope suggests that the magnetized oceanic rocks have been thrust below the continental plate. Evidence from deep-sea trenches, however, argues against the concept of thrusting of the upper surface of the basalt layer under the continental plate. — MS

**Valdes, Sylvia.** *See* Charm, W. B. 07157

07528 **Valentine, James W.** Patterns of taxonomic and ecological structure of the shelf benthos during Phanerozoic time [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 228-229, 1969.

**Valentine, L. D.** *See* Herz, Norman. 00215

07719 **VanAlstine, R. E.** Geology and mineral deposits of the Poncha Springs NE quadrangle, Chaffee County, Colorado, *with a section on* Fluorspar mines and prospects by R. E. Van Alstine and D. C. Cox: U.S. Geol. Survey Prof. Paper 626, 52 p., illus., tables, geol. maps, 1969.

Results of investigation of major deposits of fluorspar formed along faults adjoining the Arkansas Valley trough under essentially hot-spring conditions (about 119°-168°C) are reported. Deposits of copper, gold, gravel and sand, peat, pegmatite, pumice and perlite, quartzite, and vermiculite also have been exploited and are described. Formations are: Precambrian gneisses, quartz monzonite, and tabular intrusive rocks; Tertiary volcanic and sedimentary rocks; and unconsolidated Pleistocene and Holocene deposits. Tertiary units, including two new formations, are dated by vertebrate fossils, plant fossils, or the K-Ar method. Five terraced gravel deposits are probably of Wisconsinan age, and four Pleistocene gravels are successively older. — REV

07595 **VanAlstine, Ralph E.; Cox, Doak C.** Fluorspar mines and prospects, *in* Geology and mineral deposits of the Poncha Springs NE quadrangle, Chaffee County, Colorado: U.S. Geol. Survey Prof. Paper 626, p. 38-43, illus., 1969.

About 90 percent of the fluorspar concentrates shipped from the Browns Canyon district came from the Colorado-American mine whose workings expose three main veins — a fault zone within Precambrian rocks and fault zones between the Precambrian rocks and the Tertiary volcanic rocks. The Delay adit and Lloyd shaft explore breccia zones nearly 20 feet thick that are mineralized sporadically with fluorspar. Several thousand tons of fluorspar have been extracted from Manganese Hill and Chimney Hill mines, the first mainly in gneissic quartz monzonite and the second in silicified and chloritized rhyolitic welded tuff. The Last Chance deposit is localized along a fault that cuts gneissic quartz monzonite and a few small lenses of older metamorphic rocks. Several other deposits are examined. — MCM

07529 **vanBeek, Johannes L.** Systematic changes rhythmic beach topography [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 229, 1969.

**VanBladel, Robert.** *See* Gast, R. G. 07645

07074 **Vaněk, Jiří,** Seismic models of the upper mantle, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 276-279, illus., 1969.

Seismic models contribute toward partial qualitative solution of upper mantle problems, but further research is needed for final quantitative interpretations. Results of applications of two- and three-dimensional seismic models of problems relating to low-velocity channels and discontinuities in media with continuously variable velocity (gradient media) are summarized. — MS

07313 **VanHoeven, William, Jr.** Organic geochemistry [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 210 B, 1969.

07530 **VanHouten, Franklyn B.** Hornfels facies, Late Triassic Newark Group, New Jersey [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 229-230, 1969.

**VanVoast, W. A.** *See* Novitzki, R. P. 07233

07531 **Vaz, J. Eduardo; Senftle, Frank E.; Siegel, Frederic R.** Metamictization-thermoluminescence relations in zircon [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 230, 1969.

07532 **Vecchioli, John.** Deep-well recharge with treated sewage water at Bay Park, Long Island, N. Y. — Early findings [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 230-231, 1969.

07056 **Verhoogen, John.** Magnetic properties of rocks, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 627-633, 1969.

Definitions are presented for various types of magnetism and the properties of induced and remanent magnetization, both of which are usually components of the magnetization of a rock, are discussed in detail. The data indicate that in continental regions the upper mantle is purely paramagnetic and in oceanic regions is probably not magnetic below a depth of some 30 km in areas of low or average heat flow and at shallower depths in areas of high heat flow. — MS

07647 **Verma, Shive D.; Rust, R. H.** Observations on opal phytoliths in a soil biosequence in southeastern Minnesota: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 749-751, illus., table, 1969.

Opal phytoliths were identified in several horizons of a Mollisol and two Alfisols forming a biosequence. Highest opal contents were found in soils formed under tall grass native vegetation. The soils have developed in two materials with material II at about 50 cm. An increase in opal content at the top of material II may be related to an earlier grass-covered landscape. — Soil brief

07674 **Versey, H. R.** Kaolin deposits of Jamaica, *in* Internat. Geol. Cong., 23d, Prague, 1968, Symposium 1, Proc., Kaolin deposits of the world — [Pt.] B, Oversea countries (Rept. 16): Prague, Academia, p. 101-103, illus., 1969.

There are only three significant deposits of kaolinitic clay known in Jamaica, the Black River deposits, the Above River deposits, and the Jobs Hill dickite. Each has a different mode of origin, the Black River deposits being alluvial, the Above River deposits residual, and the Jobs Hill hydrothermal. The first is the largest, exceeding several million tons; the Above River deposits are the second largest; and the Jobs Hill dickite is the smallest. Studies from different technological standpoints have been made on each but none is as yet exploited. Their locations are shown in a figure. — GV

07533 **Vine, F. J.** Paradoxes in the Pacific [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 231, 1969.

07534 **Vine, F. J.** Sea-floor spreading and continental drift [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 231-232, 1969.

07597 **Vine, James D.; Tourtelot, Elizabeth B.** Geochemical investigations of some black shales and associated rocks: U.S. Geol. Survey Bull. 1314-A, p. A1-A43, illus., tables, 1969.

Nine diverse sample sets of Precambrian to Eocene black shale (marine or saline-lake deposited) from midwestern United States were examined statistically for elements which accompany major rock-forming constituents. Elements in primarily detrital fractions in any one set show a small range in abundance, those in carbonate fractions greater ranges. Minor elements associated with organic matter show more percentile range within individual sets and a greater range of median values between sets than do those in the detrital fraction; associations also tend to differ between sets. Greatest enrichment is in the Nonesuch Shale of Michigan where copper and silver show no association with any major rock constituents. Search for "metal-rich" black shales should consider primarily the more mobile elements. — GDC

07720 **Vine, James D.** Geology and coal resources of the Cumberland, Hobart, and Maple Valley quadrangles, King County, Washington: U.S. Geol. Survey Prof. Paper 624, 67 p., illus., tables, geol. map, 1969.

The Cumberland, Hobart, and Maple Valley quadrangles lie along the west flank of the Cascade Range, southeast of Seattle, Wash. Coal-bearing nonmarine sedimentary rocks of Eocene age, more than 6,000 feet thick in the Cumberland quadrangle, intertongue with marine and nonmarine sedimentary rocks and clastic volcanic rocks of the same age, as much as 14,000 feet thick in the Hobart quadrangle. These are overlain in turn by younger Tertiary sedimentary and volcanic rocks and widespread Pleistocene glacial drift deposits. Floral stages established by J. A. Wolfe in the coal-bearing sequence make possible stratigraphic correlation with the volcanic facies in spite of complex folding, faulting, and igneous intrusion. Coal resources are estimated as 600 million tons, with about three-fourths of bituminous rank. Potential resources are probably much greater. — JDV

07055 **Vogt, Peter R.; Schneider, Eric D.; Johnson, G. Leonard.** The crust and upper mantle beneath the sea, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 556-617, illus., 1969.

The principal characteristics of the sedimentary cover and physiography of the ocean floor and the igneous crust beneath the floor are summarized and various crustal and upper mantle models are analyzed. Much of the data supports the assumption that there has been a continuous process of production of crust in one region, destruction in another, involving generation of crust by sea-floor accretion of mantle derivatives at the axis of mid-oceanic ridges and recycling of crustal material, together with sediment carried along as "passive cargo," through the mantle. — MS

07679 **Vokes, Harold E.** Observations on the genus *Miltha* (Mollusca: Bivalvia) with notes on the type and the Florida Neogene species: Tulane Studies Geology and Paleontology, v. 7, no. 3, p. 93-126, illus., table, 1969.

The lucinid genus *Miltha* H. and A. Adams, 1857 has been widely misinterpreted owing to rarity of the type species, *Lucina childrenae* Gray, in museum collections. As a result, 14 species from the Tertiary of eastern North America have been referred to *Miltha*; of these, only *M. chipolana* (Dall) and *M. caloosaensis* (Dall), from the Miocene and Pliocene of Florida, are here accepted as correctly referred. These, plus *M. carmenae*, n. sp., from early Pleistocene beds in southern Florida, and the type species, living off the coast of Brazil, are described herein. Two species are placed in synonymy of *M. chipolana*, and the other 10 are referred to genera *Armimiltha*, *Eomiltha*, *Plastomiltha*, *Saxolucina*. *Miltha s.s.* is restricted to species characterized chiefly by unequal inflation of the opposite valves. — VMJ

07680 **Vokes, Harold E.** Notes on the fauna of the Chipola Formation — [Pt.] 1, A new species of *Eomiltha* (Mollusca: Bivalvia): Tulane Studies Geology and Paleontology, v. 7, no. 3, p. 126-130, illus., 1969.

*Eomiltha scolario*, n. sp., herein described, represents the first record of the genus in the faunas from the type area of the early Miocene Chipola Formation in Calhoun County, Fla.; this rather rare species most closely resembles the Claibornian Eocene *E. pandata* (*Conrad*). *Species of Eomiltha* may be distinguished from those referred to the closely related lucinid genus *Miltha s.s.* (H. E. Vokes, 1969), common in the Florida Neogene, by their equally inflated valves of more elongate shape; essential shell characters of the two genera are compared. — VMJ

07093 **VonHerzen, R. P.; Lee, W. H. K.** Heat flow in oceanic regions, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 88-95, illus., tables, 1969.

Average heat-flow values for the continents are generally similar to those for oceanic regions. Anomalously high values associated with oceanic ridges may be related to mantle convection but may also be due in part to variations in chemical differentiation of the mantle and crust. Interpretation of heat-flow measurements together with geologic and geophysical data will result in a better understanding of the variability of the heat-flow pattern. — MS

**Waagé, Karl M.** *See* Dunbar, Carl O. 07172

07649 **Wagner, Walter R.** Representative gamma-ray logs from shallow and deep wells, western Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 178, 2 sheets, 1969.

Plate 1 shows the sedimentary column obtained from the deep Temple well in Mercer County, one of four basement tests in the State; generalized lithology is related to the gamma-ray log to indicate positions of the reported gamma-ray boundaries. Plate 2 contains three gamma logs, two from the oil belt and one from the gas fields; each log is divided into the Pennsylvanian, Mississippian, and Devonian Systems, the latter further subdivided into four zones. Individual sands are not identified and zones are based essentially on presence or absence of sandstone. Zonal boundaries, because of lithologic connotation, do not necessarily represent equivalent points on each log. Regional cross sections based on gamma-ray correlation and showing zonal subdivisions and specific sand names are now in preparation. — MCM

**Wagner, Walter R.** *See* Kelley, Dana R. 07650

07182 **Wai, Chien M.; Wasson, John T.** Silicon concentrations in the metal of iron meteorites: Geochim. et Cosmochim. Acta, v. 33, no. 12, p. 1465-1471, illus., tables, 1969.

Electron microprobe determinations of Si in the metal of 19 iron meteorites, including representatives of the nine chemical groups, reveal Si concentrations below our detection limit (about 25 ppm) in all but two cases. The two objects are Tucson, an iron of anomalous composition containing highly reduced silicate inclusions, and Horse Creek, a meteorite which is more appropriately classified with the enstatite chondrites than with the iron meteorites. We conclude that most (probably more than 99 percent) of the iron meteorites contain less than 30 ppm Si in the metal, and that meteoritic evidence for the presence of Si in the Earth's core is very weak. Some details regarding the structures and composition of Tucson are given. — Authors' abstract

**Wainerdi, R. E.** *See* Santos, G. G. 07742

07187 **Waldbaum, D. R.; Thompson, J. B., Jr.** Mixing properties of sanidine crystalline solutions — [Pt.] 4, Phase diagrams from equations of state: Am. Mineralogist, v. 54, nos. 9-10, p. 1274-1298, illus., tables, 1969.

Provisional values of mixing parameters for $NaAlSi_3O_8$-$KAlSi_3O_8$ liquids at one atmosphere may be calculated from the minimum melting temperature and composition given by Schairer (1950). From these, preliminary estimates are obtained of the

solidus for Na-rich compositions and the metastable solidus and liquidus in the composition range where alkali feldspar melts to leucite and a liquid displaced toward $SiO_2$ from the feldspar join. The effect of the component $KAlSi_2O_6$ on equilibria between alkali feldspars, jadeite, and quartz was calculated for temperatures up to 1300°C and 32 kbar. The calculated four-phase equilibrium between quartz, jadeite, and two alkali feldspars intersects the line of critical solution at about 26 kbar, and terminates there at a critical end-point. — *from* Authors' abstract

07273 **Walker, Jack R.; Garrison, Louis E.** How far offshore is the oil,: Oil and Gas Jour., v. 67, no. 48, p. 88-93, illus., 1969.

A recent complete marine geophysical survey of the Gulf of Mexico suggests that favorable geologic conditions exist in the deep waters of the Gulf and that large accumulations of oil and gas may be found in almost every part. Interpretation of the geophysical data indicates that the deep offshore contains an extremely thick marine sedimentary section folded into an enormous number of large structural features, and a trend of probable reefing can be traced for over 1,000 miles along the southern and eastern carbonate banks. — WBC

07535 **Walter, Louis S.; Doan, Arthur S.** Determination of oxygen activities of chondritic meteorites [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 232-233, table, 1969.

**Ward, Stanley H.** *See* Fuller, Brent D. 00082

07624 **Warren, Charles R.** Glacial Lake Norfolk and drainage changes near Norfolk, Connecticut, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D200-D205, illus., 1969.

In the Norfolk quadrangle, Connecticut, glacial drift has disrupted the preglacial drainage pattern in the headwaters of the Blackberry River, a west-flowing tributary of the Housatonic. Of four streams that flowed generally northward in preglacial time, three have been diverted so that their waters repeatedly cross inferred preglacial divides. Much of the glacial drift that diverts these streams was deposited in an ice-marginal lake, glacial Lake Norfolk. — Author's abstract

**Warren, David H.** *See* Healy, John H. 07103

**Wasson, John T.** *See* Wai, Chien M. 07182

07344 **Waters, Aaron C.** Geology of the southern half of the Chelan quadrangle, Washington [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2259B-2260B, 1969.

07536 **Watson, G. S.** Trend surface analysis and spatial correlation [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 233, 1969.

00083 **Watson, Jerry A.; Johnson, G. Leonard.** Deep ocean structures off Grand Banks may contain oil: Ocean Industry, v. 5, no. 2, p. 57-60, illus., 1970.

Seismic surveys, using multiple air guns for reflection profiling seaward of the Grand Banks, show that diapirs lie below the deep ocean floor, adding to evidence that petroleum reserves may exist in deep ocean basins. Possible drilling sites are under consideration. These structures do not produce magnetic anomalies, so are not volcanic, but do lack the well-developed rim synclines of salt domes. Salt is known to exist under parts of the Grand Banks and in the Senegal basin west of Africa. A belt of evaporites may have formed in the shallow proto-Atlantic and was broken by rifting and continental drift. — ESL

**Waugh, Truman C.** *See* Tien, Pei-lin. 07194

07149 **Wayne, William J.** Urban geology — A need and a challenge: Indiana Acad. Sci. Proc. 1968, v. 78, p. 49-64, illus., 1969.

Urban land uses are rapidly converting open land into intensively used land. Generally, in planning those uses, a comprehensive study has included everything except an evaluation of the land in three dimensions. Geologists are eminently well equipped to supply the missing data, but they must also be aware of the needs of the urban community and the kinds of information needed by planners of the urban community and the kinds of information needed by planners if they are to write reports usable by planners. Urban and environmental geology is a newly expanding field in the use of geologic data to help solve some urban problems in the planning stage. It is likely to become a part of the curriculum in many college geology departments within the next few years. — Author's summary

07537 **Weaver, Charles E.; Beck, Kevin C.** Changes in the clay-water system with depth, temperature, and time [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 233-234, 1969.

**Webb, Douglas.** *See* Howard, James F. 07377

07113 **Webb, E. J.** Geologic history of the Cambrian system in the Appalachian basin, *in* Kentucky Oil and Gass Assoc., 33d Ann. Mtg., 1969, Proc. Tech. Sess.: Kentucky Geol. Survey, ser. 10, Spec. Pub. 18, p. 7-15, illus., 1969.

A study of the geologic history of the Cambrian System in the Appalachian basin provides vital clues concerning oil and gas entrapment. Clastic deposition combined with early tectonic activity in the basin created an excellent environment for the entrapment of hydrocarbons. The future of the oil and gas industry in Kentucky is dependent on drilling to these deeper accumulations. — Author's abstract

07167 **Webb, S. David.** Extinction-origination equilibria in late Cenozoic land mammals of North America: Evolution, v. 23, no. 4, p. 688-702, illus., tables, 1969.

The changing diversity of North American land mammal genera from early Pliocene to the present forms a large-scale extinction-origination equilibrium pattern similar to that hypothesized by MacArthur and Wilson (1963, 1967) for island zoogeography. Analysis of supposedly cataclysmic extinctions shows them to be either gradual events or, as in the late Pleistocene, small-scale pulsations. Extinction and origination rates for each major adaptive group (carnivores, omnivores, herbivores) were in balance throughout the past 10 m.y., although the equilibrium point shifted gradually. A rising extinction curve in the late Pleistocene coincided with climatic deterioration that affected chiefly the large herbivores and large carnivores; extinctions of these were balanced, however, by originations of small forms in the same groups. — VMJ

00125 **Weber, Dwight.** Kornelite at Coso Hot Springs: California Div. Mines and Geology Mineral Inf. Service, v. 23, no. 1, p. 6, 1970.

Kornelite has not been reported previously from California. It occurs as well-formed acicular prisms arranged as rosettes, and in platy compact masses, pale violet to pink in color. The mineral apparently formed as a result of alteration of coquimbite. An X-ray powder pattern indicates good agreement with the data of Cesbron (1964) on kornelite from Utah. Further studies are in progress. — ESL

**Weber, Robert H.** *See* Kottlowski, Frank E. 07573

**Weber, Walter J.** *See* Mattson, James S. 07246

07646 **Weed, S. B.; Davey, C. B.; Cook, M. G.** Weathering of mica by fungi: Soil Sci. Soc. America Proc., v. 33, no. 5, p. 702-706, illus., tables, 1969.

Three trioctahedral micas and one dioctahedral mica (1–$\mu$ size fractions) were used as $K^+$-sources for seven fungi grown in nutrient solution buffered at pH 6. Expanded mica, i.e., vermiculite, formed at the expense of mica. The fungi differed in their abilities to utilize mica $K^+$. The alteration mechanism involved was exchange of solution $Na^+$ for $K^+$ in the micas, the fungi serving as $K^+$-sinks. — Soil brief

**Weeks, E. P.** *See* Stallman, R. W. 07503

07538 **Weldie, A. E.** Gulf of Mexico — Southern structural margin [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 234, 1969.

07261 **Welken, Karl.** Prof. Dr. Bernhard Brockamps Verdienste um die deutsche Polarforschung und um die Deutsche Gesselschaft für Polarforschung: Polarforschung 1968, v. 38, pt. 6, nos. 1-2, p. 190-193, [1969].

00187 **Well, Charles B.** Sediment distribution in the upper Delaware River Estuary [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 40, 1970.

07283 **Wels, Leonard W.; Schwartz, Leander J.** Interdisciplinary honors program in introductory geology and biology: Jour. Geol. Education, v. 17, no. 5, p. 175-178, tables, 1969.

The honors seminar section at the University of Wisconsin at Green Bay, Wis., open to students currently enrolled in regular introductory courses, will permit them to delve more deeply into subjects of special interest. Evolution was selected as the first topic. Instructors gave the first two seminars to show the relation of the topic to each field. Student presentations lasted about 30 minutes, and were followed by discussion; each emphasized the subject in which he was enrolled. Students responded very enthusiastically and recommended continuation of the program with more disciplines, as well as adoption of this format for nonhonors sections. — *from* Authors' abstract

07053 **Wellman, H. W.** Wrench (transcurrent) fault systems, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 544-549, illus., table, 1969.

Data on the sense and rate of displacement, lengths, and other features of 25 major wrench faults of the world are presented in tabular form. Displacement of topographic features is an index of the fault activity, whose magnitude can be inferred by the age of the displaced features and less accurately by the degree of definition of the fault trace. Some displacements may have been gradual, but most were probably sudden and accompanied by major earthquakes. — MS

07353 **Wells, John Maurice.** Spherical harmonic analysis of paleomagnetic data [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2264B-2265B, 1969.

07539 **Wenner, David B.; Taylor, Hugh P., Jr.** $\delta D$ and $\delta O^{18}$ studies of serpentinization of ultramafic rocks [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 234-235, 1969.

07224 **West, Ronald Robert.** Marine communities of a portion of the Wewoka Formation (Pennsylvanian) in Hughes County, Oklahoma [abs.]: Oklahoma Geology Notes, v. 29, no. 6, p. 154-155, 1969.

07540 **West, Terry R.** Subsurface investigation for a power transmission line in northwestern Indiana [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 235, 1969.

**Wetherill, George W.** *See* Kaushal, Sushil K. 00088

07319 **Wetzel, Richard Allen.** Axisymmetric stress wave propagation in sand [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2160B-2161B, 1969.

07345 **Whaley, Peter Walter.** A litho-genetic model for rocks of a lower deltaic plain sequence [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2260B, 1969.

**White, A. J. R.** *See* Taylor, S. R. 07364

07541 **White, George W.** Anatomy of till deposits — Engineering implications [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 235-236, 1969.

07659 **White, George W.; Totten, Stanley M.; Gross, David L.** Pleistocene stratigraphy of northwestern Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Buil. G 55 (Gen. Geology Rept.), 88 p., illus., tables, 1969.

Northwestern Pennsylvania is covered with glacial drift brought by continental ice sheets from the Erie basin. Described in detail are the older Slippery Rock, Mapledale, Titusville, Kent and Lavery Tills, and briefly the Hiram and Ashtabula Tills. Type locality, extent, composition, weathering character, stratigraphic position, and age and correlation for each till are considered. Petrography and areal variation of the Mapledale, Titusville, Kent and Lavery tills are shown in texture and feldspar content, percentages of potassium feldspar, heavy minerals, and carbonates. The summarized Pleistocene history includes ice-sheet advances, climatic changes, and weathering intervals. There are several measured sections and cross-section sketches. — GDC

07235 **White, John A.** Late Cenozoic bats (Subfamily Nyctophilinae) from the Anza-Borrego Desert of California, *in* Contributions in mammalogy — A volume honoring Prof. E. Raymond Hall: Kansas Univ. Mus. Nat. History Misc. Pub. 51, p. 275-282, illus., tables, 1969.

*Anzanycteris anzanensis*, n.gen., n.sp., is described from the early Pleistocene Diablo Member of the Palm Spring Formation in Anza-Borrego Desert State Park, San Diego County, Calif. The incomplete skull, articulated jaws, and teeth are compared with those of extant nyctophiline genera. The new species is morphologically distinct from *Antrozous* and *Bauerus*, the two currently recognized (Van Gelder, 1959) subgenera of *Antrozous* in North America, to the same extent that the subgenera differ from each other. On the basis of dentition, jaw articulation and cranial dimensions, *Anzanycteris*, n.gen., is established, and *Bauerus* is elevated to generic rank. The four nyctophiline genera form a morphological series, with *Nyctophilus* the most primitive and *Anzanycteris* the most advanced. — VMJ

07203 **White, John S., Jr.** A lithiophosphate occurrence in North Carolina: Am. Mineralogist, v. 54, nos. 9-10, p. 1467-1469, table, 1969.

The first known occurrence of lithiophosphate was in a Russian pegmatite, described in 1957. The second is in a spodumene mine at Kings Mtn., N.C., where it occurs as colorless crystals and in colorless to buff masses on crystal druses lining open fissures in massive pegmatite, suggesting a late origin. The crystals resemble topaz in habit. A distinct [110] cleavage causes a diamond shaped cross-hatching and saw-tooth edges. Optical properties and specific gravity are compared with the Russian and synthetic specimens. — ESL

00098 **White, William A.** Erosion of cirques: Jour. Geology, v. 78, no. 1, p. 123-126, illus., 1970.

It is suggested that cirques are formed by deepening through glacial erosion on their floors rather than by headward sapping on their walls. This idea is supported by: (1) dovetailing or interfingering of cirques on opposite sides of narrow arêtes which are serpentine in plan; (2) crater cirques that occupy the entire top of individual mountains without breaches in their enclosing walls; and (3) the rarity of cols and greater rarity of passes in narrow aretes. — Author's abstract

07542 **Whitmore, Frank C., Jr.** Ecologic and stratigraphic implications of some Cenozoic vertebrates in the Atlantic Coastal Plain [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 236, 1969.

**Wilhelm, E. J.** *See* Winkler, E. M. 00111

**Wilkens, Richard A.** *See* MacNish, Robert D. 07242

**Wilkinson, J. F. G.** *See* Nash, William P. 07695

**Wilkinson, John W.** *See* Park, Richard A. 07715

07543 **Wilkinson, Thomas A.; Guertin, Joseph D.** American Falls — Preservation and enhancement study [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 236-237, 1969.

**Willard, Max E.** *See* Kottlowski, Frank E. 07573

**Williams, E. G.** *See* Lowright, R. H. 00167

**Williams, Eugene G.** *See* Bragonier, William A. 00143

**Williams, Eugene G.** *See* Swinehart, James B. 00185

00188 **Williams, Harold.** Relationships between late Precambrian and Paleozoic rocks at Belle Bay, eastern Newfoundland [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 40-41, 1970.

07544 **Williams, Richard J.; Eugster, H. P.** An experimental study of (Fe,Mg) olivine-(Fe, Mg) pyroxene reactions and their geological applications [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 237, 1969.

07545 **Williamson, Terrance C.; Myer, George H.** A pyrrhotite-pyrite isograd in the Waterville area, Maine [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 237-238, 1969.

07643 **Wilshire, H. G.; Trask, N. J.** Hornblende-bearing ultramafic inclusions from Siberia and Dish Hill craters, California [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 295-297, illus., 1969.

00189 **Wilson, Peter G.** Role of geology in a comprehensive environmental-urban planning program for West Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 41, 1970.

07671 **Winchester, J. W.; Catoggio, J. A.** Application of neutron activation analysis to geochemical studies of mineral resources, *in* Nuclear techniques and mineral resources — Symposium, Buenos Aires, 1968, Proc.: Vienna, Austria, Internat. Atomic Energy Agency, p. 435-449, illus., tables, discussion, 1969.

Sensitive and accurate measurement of closely related trace element concentrations in naturally occurring materials leads to the most useful geochemical information in the study of crystallizing systems. Studies of the rare earth elements have shown regularities that can be related to geological crystallization processes in igneous and sedimentary materials, and it is likely that similar studies of economic mineral deposits will lead to similar information. An analytical method should be chosen with great care to assure adequate sensitivity for the trace elements under investigation. Neutron activation analysis and spark source mass spectrometry both have high sensitivity adequate for many geochemical applications. However, simpler methods, such as atomic absorption, absorption spectrophotometry and electrochemical methods have adequate sensitivity for many elements and are preferred when suitable. — Authors'abstract

07546 **Wing, Richard S.; Overbey, William K., Jr.; Dellwig, Louis F.** Radar lineament analysis, Burning Springs area, West Virginia [abs.]: Geol. Soc. America Abs. with Program 1969, pt. 7, p. 238-239, 1969.

00111 **Winkler, E. M.; Wilhelm, E. J.** Salt burst by hydration pressures in architectural stone in urban atmosphere: Geol. Soc. America Bull., v. 81, no. 2, p. 567-572, illus., tables, 1970.

Water-soluble salts and their hydrates are trapped in pores of stone and concrete. The crystallization of the salts and their recrystallization from a lower to a higher hydrate within the range of mineral stability may develop stresses of high magnitude. Theoretical bursting pressures were calculated thermodynamically from vapor pressures of the hydrates and from humidities of the air for several air temperatures. [Urban atmospheres polluted with sulfuric and carbonic acids are especially aggressive toward stone structures.] — *from* Authors' abstract

07547 **Winland, H. Dale; Matthews, R. K.** Origin of Recent grapestone grains, Bahama Islands [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 239, 1969.

07548 **Winograd, Isaac J.; Friedman, Irving.** Delineation of regional ground water flow systems using deuterium, eastern Great Basin, Nevada [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 239-240, 1969.

07272 **Winston, George O.** A deep glimpse of West Florida's Platform: Oil and Gas Jour., v. 67, no. 48, p. 128-129, 132-133, illus., 1969.

This estimate of the character of the stratigraphy of the West Florida Platform is based on correlations of offshore seismic data and onshore subsurface geology and a comparison of the platform with better-known areas of similar geologic setting. The study indicates that rocks of Lower Cretaceous, Upper Jurassic and Upper Cretaceous (listed in the order of their importance) contain salt structures, basin-to-shore facies, and reef developments that are favorable for the accumulation of oil. — WBC

07549 **Winstonk, Judith E.; Anderson, Franz E.** Biogenic disturbance of estuarine sediments [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 240, 1969.

07550 **Winterer, Edward L.; Riedel, William R.** Preliminary scientific results of Cruise VII of D/V GLOMAR CHALLENGER [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 240, 1969.

07552 **Wise, Sherwood W., Jr.** Organization and formation of fasciculi in the skeletons of scleractinian corals [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 241, 1969.

07164 **Wisecarver, David W.; Merrill, Robert H.; Stateham, Raymond M.** The microseismic technique applied to slope stability: Soc. Mining Engineers AIME Trans., v. 244, no. 4, p. 378-385, illus., 1969.

The microseismic method to evaluate stability of large, open-pit slopes has been investigated. Because stressed rock emits subaudible rock noises and noise rate and amplitude increase as stresses approach failure, detection and recording of noises serve as a semiquantitative method of predicting incipient failure. Three types of microseismic apparatus, procedures, and results of investigations in slope walls of open-pit mines near Boron, Calif., and Ely, Nev., are described. Microseismic monitoring within a frequency band of 50 to 5000 Hz indicates noise rates in stable, inactive mining areas are between 0 and 10 noises per hr; in stable, active areas, 10 to 50 per hr; and in unstable areas, as high as 2500 per hr. High microseismic noise rates in a Nevada pit correlate with time of nearby earthquakes. The technique is applicable to large pit walls, and wide-band, wide-range equipment appears suitable. — *from* Authors' abstract

07586 **Wishart, David.** FORTRAN II programs for 8 methods of cluster analysis (CLUSTAN I): Kansas Geol. Survey Computer Contr. 38, 112 p., illus., tables, 1969.

A set of programs for numerical classification of N samples according to numeric or binary variable values is given. This set forms the basis of a cluster analysis program library, CLUSTAN I. Mathematical methods used are mode analysis and the hierarchical fusion processes — nearest neighbor, farthest neighbor, group average, centroid, median, Ward's error sum method, and Lance-Williams flexible. The maximum number of samples that can be handled is 250, of variables, 200, of binary variables, 400. For the FORTRAN IV version, the number of samples is increased to 999. — ESL

07553 **Witherspoon, P. A.; Neuman, Shlomo P.** Problems in evaluating hydrologic characteristics of groundwater basins [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 241-242, 1969.

**Witherspoon, Paul Adam.** *See* Bonoli, Luciano. 07211

07309 **Witkind, Irving J.** Clinopyroxenes from acidic, intermediate, and basic rocks, Little Belt Mountains, Montana: Am. Mineralogist, v. 54, nos. 7-8, p. 1118-1138, illus., tables, 1969.

Clinopyroxenes from 18 intrusions are similar in chemical and optical properties, and cell dimensions; those from basic rocks have less $SiO_2$ but more $Al_2O_3$ than intermediate. Pyroxenes from intermediate rocks have small proportions of $Al^{3+}$ in tetrahedral coordination; those from basic rocks have high $Al_z$ which reflect molecular concentrations of $SiO_2$ in parent magma. Optical property curves give good results in determining compositions. A correlation diagram based on unit-cell dimensions $b$ and $a \sin \beta$ give good agreement for some pyroxenes from intermediate rocks, but uniformly poor agreement for all from basic rocks. Magmatic differentiation at depth by crystal settling led to formation of a crystal-enriched fraction which gave rise to the parent magma of basic rocks, and a crystal-poor differentiate which gave rise to a magma of intermediate composition. — *from* Author's abstract

07354 **Woeber, Arthur Frederick.** Influence of layer parameters on leaking modes [abs.]: Dissert. Abs. Internat., Sec. B, Sci. and Eng., v. 30, no. 5, p. 2265B, 1969.

**Wollenberg, H. A.** *See* Dodge, F. C. W. 07566

**Wood, G. Güner.** *See* Burrell, David C. 07367

**Woollard, G. P.** *See* Strange, W. E. 07123

00213 **Woollard, George P.; Kahn, Mohammad Asadullah.** A review of satellite derived figures of the geoid and their geophysical significance: Pacific Sci., v. 24, no. 1, p. 1-28, illus., tables, 1970.

The satellite tracking program has shown that the Earth is characterized by a series of previously undefined geoidal highs and lows. As they do not correlate with surface mass distribution, they may be related to regional variations in gravity due to mass distributions in the interior. Geoidal results obtained by various investigators are reviewed. The authors undertook a different approach and computed a series of geoidal maps based on various combinations of zonal and tesseral harmonic coefficients derived by various investigators, as well as maps based on mean coefficient values, and these results were then used to compute the anomalous gravity field so that direct comparisons could be made. The derived gravity field and its relation to the surface gravity field, and geophysical and geological relations in two areas of anomalous geoidal heights are discussed. — ESL

07076 **Woollard, George P.** Standardization of gravity measurements, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 283-293, illus., 1969.

A revised figure of 6,378,160 m (rather than 6,378,388 m) for the equatorial radius of the Earth and a derived mean crustal density value greater than 2.67 g/cm³ are among revisions and corrections of gravity parameters that are analyzed with reference to formulation of standards and interpretation of gravity anomalies. The anomalous relations are not due to lack of isostatic compensation, but to Earth curvature and the proximity effect inherent in gravitational attraction in zones in which there are horizontal discontinuities in mass distribution. — MS

07078 **Woollard, George P.** Regional variations in gravity, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 320-341, illus., tables, 1969.

Regional variations in gravity of four continental areas are evaluated relative to a standard defined on the basis of free-air anomaly values under isostatic conditions and Bouguer anomaly values established for the United States. Tables of the relation of anomaly values to elevation of the various areas are presented and discussed with particular reference to correlations between gravity values and topographic relief, changes in geologic structure, changes in crustal composition, and anomalous crustal thickness. — MS

07097 **Woollard, George P.** Tectonic activity in North America as indicated by earthquakes, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 125-133, illus., table, 1969.

Although there is a definite association of seismicity with certain major geologic features, there is no consistent pattern of association with specific geologic features or tectonic elements. The present pattern of seismicity is related to stress relief rather than the mechanism responsible for the global fracture pattern. A definite relationship can be demonstrated between crustal thickness and mantle velocity values. Variations in density associated with variations in crustal structures result in epeirogenic uplift and subsidence. The boundaries of the mobile crustal elements constitute zones of flexure and possible shear, and are therefore potential zones of seismicity. — MS

07206 **Wright, Alan C.; Rupert, J. Paul; Granquist, W. T.** High- and low-silica faujasites — An addendum [to 1968 paper]: Am. Mineralogist, v. 54, nos. 9-10, p. 1484-1490, illus., 1969.

The original paper (ibid., v. 53, p. 1293-1303, 1968), in a subtitle, referred to the faujasites as a substitutional series. A letter from J. V. Smith questions the small amount of amorphous silica proposed to account for displacement of the sodium form, and suggests Al, Si ordering in the natural faujasite as a more likely explanation. He cites evidence for a discontinuity in the faujasite series at Si/Al = 1.5, and objects to nomenclature proposed in the paper because it ignored this discontinuity. In Breck and Flanigen (1968), this discontinuity forms the basis for division of the series into the Zeolite X and Zeolite Y composition ranges. Wright et al. believe that the faujasite series is continuous over the stability range. The purpose of this addendum is to delineate the conflict, discuss the discontinuities described, and set the stage for further contributions. — ESL

**Wright, Frances W.** *See* Hodge, Paul W. 00196

07616 **Wright, James C.** A tuff clast from the Bidahochi Formation at Tonalea, Arizona, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D144-D147, illus., 1969.

A block of tuff, partly altered to montmorillonite and 10 feet or more in diameter, at the trading post at Tonalea, Coconino County, Ariz., is tentatively interpreted as an eroded and transported boulder from the Pliocene Bidahochi Formation. The altered tuff is very similar to an altered tuff in the Bidahochi near Sanders, Ariz., about 120 miles southeast. Because the tuff boulder probably could not have survived transport for more than a few miles, a near-shore shelf environment favorable to accumulation of such tuff near Tonalea is implied. This supports earlier evidence that the lacustrine basin, in which the Bidahochi accumulated, originally extended nearly 80 miles northwest of its previously noted outcrops near Bidahochi. — Author's abstract

07554 **Wright, Lauren A.; Troxel, Bennie W.** Chaos structure and Basin and Range normal faults — Evidence for a genetic relationship [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 242, 1969.

**Wyder, J. E.** *See* Rutter, N. W. 07132

**Wyllie, P. J.** *See* Piwinskii, A. J. 00095

07068 **Wyllie, Peter J.** The ultramafic belts, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 480-483, 1969.

Representatives of the upper mantle may be present among rocks of various ultramafic belts, but direct correlation is difficult because of the effects of fractionation, contamination, and metamorphism. No direct representatives are present in cratonic ultramafic belts, but may be present in alpine ultramafic rocks of orogenic belts and in ultramafic rocks of mid-oceanic ridges. Possible derivation of the alpine-

type rocks from cumulates in basic stratiform intrusions or volcanic conduits poses problems of interpretation. — MS

07555 **Wyllie, Peter J.** Ultramafic rocks and the upper mantle [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 243, 1969.

**Yaroshevsky, A. A.** *See* Ronov, A. B. 07089

07556 **Yeats, Robert S.; Turner, Donald L.** Age relationships between eastern Pacific magnetic anomalies and volcanic rocks in the California Coast Ranges [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 243-244, 1969.

00190 **Yewislak, Paul P., Jr.** Geology of the Culpeper Triassic Basin, Virginia [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 41-42, 1970.

07744 **Yochelson, Ellis L.** Fossils, the how and why of collecting and storing, *in* Natural history collections, past, present, future — Symposium, 1968: Biol. Soc. Washington Proc., v. 82. [art.] 49, p. 585-601, 1969.

This paper is an essay-review on old and modern methods of collecting fossils and scientifically storing them in museums; the statements apply chiefly to the combined U.S. Geological Survey-Smithsonian Institution collection in Washington, D. C. Physical limitations in collecting and storing methods, criteria for keeping or discarding material, and the various storage systems (biologic, stratigraphic, alphabetical for types) are discussed. Although sources of fossils collected by conventional hand methods are decreasing, the increasing bulk of silicified fossils and of microfossils now being collected and processed will require increasing space and improved handling and storage techniques. — VMJ

07724 **Young, E. J.; Myers, A. T.; Munson, Elaine L.; Conklin, Nancy M.** Mineralogy and geochemistry of fluorapatite from Cerro de Mercado, Durango, Mexico, *in* Geological Survey research 1969, Chap. D: U.S. Geol. Survey Prof. Paper 650-D, p. D84-D93, illus., tables, 1969.

Fluorapatite from Cerro de Mercado has been known to world mineral collectors for its yellow color, transparency, and perfect crystal form. Because this fluorapatite was considered for use as a phosphate reference standard in spectrochemical laboratories of the U.S.G.S., knowledge of its complete chemical composition and physical properties became necessary. The fluorapatite principally contains rare earths, but also a rather large number of minor elements. Although the apatite is intimately associated with martite, no FeO was found by chemical analysis, and $Fe_2O_3$ in amount of only 0.06 percent. Physical properties of the analyzed apatite are: $o$=1.6362±0.0005, $e$=1.6326±0.0005; $a$=9.391±0.001 A, $c$=6.878±0.002 A; measured specific gravity (22°C), 3.216; calculated density (22°C), 3.219; magnetic susceptibility, $-0.078\times10^{-6}$ emu/g. — *from* Authors' abstract

07557 **Ypma, Peter J. M.; Lukowsky, J. Ann.** The use of an electro-optical compensator for the determination of optical properties of opaque minerals under the microscope [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 244, 1969.

07175 **Zajic, James E.** Microbial biogeochemistry: New York and London, Academic Press, 345 p., illus., tables, 1969.

Literature and information of microbiology and geology are combined in 19 chapters: laboratory and *in situ* leaching techniques; microbial metabolism of inorganic sulfur; sulfate reduction and sulfides; biotransformation of iron; copper biogeochemistry; microbes and zinc; microbes and manganese; microbes and cobalt; uranium biogeochemistry; vanadium biogeochemistry; aluminum and microbes; biogeochemistry of silicon; microbial corrosion and oxidation of metallic iron; calcium; sodium chloride, salts and halophiles; biogeochemical topics; and biogeochemical observations on other elements. References are given at the end of each chapter; author and subject indexes are appended. — MCM

07583 **Zen, E-an.** Petrographic evidence for polymetamorphism in the western part of the northern Appalachians and a possible regional chronology [summ.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 297-299, 1969.

00119 **Zenger, Donald H.** The role of rapid events in earth history: Jour. Geol. Education, v. 18, no. 1 p. 42-43, 1970.

Attention is focused on the fact that a sizeable part of the crust developed through sudden and dramatic events. Volcanoes, large landslides, flash floods, major forest fires, turbidity currents, and storm waves are examples of "catastrophic" events. — ESL

07737 **Zenkovich, V. P.** Pribrezhnyye melkovod'ya Zapadnoy Kuby i ikh otlozheniya [Coastal shoals of western Cuba and their deposits]: Okeanologiya, v. 9, no. 2, p. 256-270, illus., 1969; English translation, Oceanology, v. 9, no. 2, p. 207-221, illus., 1969.

On the 1965 Soviet-Cuban expedition to study the coastal geology of Cuba, 47 cores were taken with a vibrating piston tube, and numerous bottom and surface samples were obtained. Extensive shoals, in the south up to 50 to 100 km wide, are flanked by old coral reefs and outer island chains. The effect of sea swell, tides, surging and hurricanes on various parts of the coast are described. Complex mesorelief of transverse, longitudinal, and overlapping ridges, and sand barchans are found on sandy, flat-bottomed areas between reefs and island chains. Ridges of fine calcareous mud and fragments of organisms form on limestone foundations near estuaries, usually at right angles to the coast. They are sometimes stabilized by mangrove colonies, but otherwise continue to more and reform. Turtle grass, *Thalassia*, colonies and mangrove thickets are sources of scattered small peat deposits. — EH

07059 **Zharkov, V. N.; Kalinin, V. A.** Equation of state at high pressure, *in* The Earth's crust and upper mantle: Am. Geophys. Union Geophys. Mon. 13 (Natl. Acad. Sci.-Natl. Research Council Pub. 1708), p. 650-659, illus., tables, 1969.

Equations of state at absolute zero and after phase transition are derived on the basis of theoretical, shock-wave, and other experimental data. Phase transitions of geophysical importance are polymorphic transitions accompanied by change in crystal symmetry and volume increase, metallization, and melting. The various parameters involved in the equations are discussed in some detail, with reference to calculations incorporating the relationships of pressure, volume, and temperature, in the light of their significance for studies of the Earth's interior. — MS

**Zietz, Isidore.** *See* Andreasen, Gordon E. 07147

**Zietz, Isidore.** *See* King, Elizabeth R. 07405

07558 **Zietz, Isidore; Andreasen, Gordon E.; Cain, J. C.** Magnetic anomalies from a satellite magnetometer [abs.]: Geol. Soc. America Abs. with Programs 1969, pt. 7, p. 244, 1969.

00191 **Zimmerman, Herman B.** Bottom current data for the continental rise off New England [abs.]: Geol. Soc. America Abs. with Programs, v. 2, no. 1, p. 42, 1970.

00080 **Zimmerman, Joan.** The strange world of helium: Chemistry, v. 43, no. 2, p. 14-17, illus., 1970.

Helium was named by J. N. Lockyer (in England), who had observed a new bright, yellow line in the solar spectrum in 1868; Janssen in India also observed it about the same time. Today it is accepted that all terrestrial helium results from alpha-emitting elements. Production, uses, and properties are discussed, and the discovery of a second liquid phase, helium II, is described. This phase conducts heat a million times more efficiently than helium I and also has the useful property of superfluidity. The extremely low temperatures made possible by both helium I and II produce superconductivity in metals. The relation between superfluidity and superconductivity, and the isotopes, helium-3 and -4, are discussed. — ESL

**Zukas, E. G.** *See* Green, W. V. 00091

# INDEX

[The numbers refer to entries in the abstracts]


**Absolute age, dates**
*Beach rock*
Florida, Cape Kennedy, barrier-lagoon complex: Osmond, J. K. 00089
*Carbon-14*
Alaska, White River Valley, glacial chronology: Stuiver, Minze. 07512
California, Mono Basin sediments: Lajoie, Kenneth R. 07634
Florida, Everglades, upper, peat profile: McDowell, L. L. 07644
Oregon, Newberry Caldera, wood: Higgins, Michael W. 07605
Rhode Island, southern, lagoon sediments: Dillon, William P. 00096
Texas, Galveston Bay, Holocene sediments: Rehkemper, Leonard James. 07338
Yukon, Saint Elias Mts., glacial chronology: Denton, George H. 07361
*Dredge samples*
Atlantic Ocean, mid-Atlantic Mid-Atlantic Ridge, fission-track: Aumento, F. 07302
*Granitic rocks*
California-Nevada, Mesozoic intrusive epochs: Evernden, J. F. 00208
Washington, Okanogan Range, Cretaceous orogenic phase: Menzer, Fred J., Jr. 00200
*Igneous rocks*
Alaska, Coast Range batholith, related rocks, K-Ar: Forbes, Robert B. 00201
Arizona, Gila County, Precambrian: Livingston, Donald E. 07418
Colorado, Oligocene tuff and flow, K-Ar: VanAlstine, R. E. 07719
Colorado, San Juan Mts., Ute Creek melasyenite: Barker, Fred. 00133
Guatemala, Chiquimula pluton, Rb-Sr: Long, Leon E. 07420
New England, White Mountain magma series, K-Ar: Foland, K. A. 00155
New Mexico, Tertiary intrusive-volcanic-mineralization episodes: Kottlowski, Frank E. 07573
New York, Hudson Highlands, Rosetown complex, K-Ar: Ratcliffe, Nicholas M. 00176
Utah, southeastern, Mule Ear diatreme: Naeser, C. W. 07692
*Interpretation*
California, Coast Ranges, magnetic anomalies, volcanics: Yeats, Robert S. 07556
Ontario, Ottawa area, bog sections, pollen zones: Mott, R. J. 07601
Precambrian complexes, growth of continents: Kuno, Hisashi. 07064
*Metamorphic rocks*
Alaska, Coast Range batholith, related rocks, K-Ar: Forbes, Robert B. 00201
Appalachians, northern, Rb-Sr, K-Ar: Zen, E-an. 07583

**Absolute age, dates—Continued**
*Metamorphic rocks*—Continued
*Meteorites*
Carbonaceous chondrites, Rb-87:Sr-87: Kaushal, Sushil K. 00088
*Minerals*
North America, shield areas, galena: Tilton, G. R. 07523
*Shells*
Florida, Cape Kennedy, barrier-lagoon complex: Osmond, J. K. 00089
**Absolute age, methods**
*Carbon-14*
Liquid scintillation counting: Kim, Stephen M. 07245
Liquid scintillation counting, low level: Kim, Stephen M. 07244
Theory, early experiments, development of method: Libby, W. F. 07281
*Potassium-argon*
Principles, techniques, applications to geochronology: Dalrymple, G. Brent. 07177
*Rubidium-strontium*
Sediments, sedimentary rocks, constraints: Dasch, E. Julius. 07183
**Alabama**
*Stratigraphy*
Ordovician, Upper: Neathery, Thornton L. 07696
**Alaska**
*Absolute age*
Coast Range batholith and related rocks, K-Ar: Forbes, Robert B. 00201
White River Valley, glacial chronology, C-14: Stuiver, Minze. 07512
*Areal geology*
Cosmos Hills, southeastern: Fritts, Crawford E. 07279
*Earthquakes*
March 28, 1964, deformation: Plafker, George. 07155
*Economic geology*
Metals, Kanuti River region, exploration, occurrence: Patton, William W., Jr. 00130
*Geochemistry*
Kanuti River region, geochemical prospecting: Patton, William W., Jr. 00130
Kruzof Island, Edgecumbe Volcanics, analyses: Brew, David A. 07603
*Geophysical surveys*
Continental margins, gravity anomalies, isostatic adjustment lacking: Barnes, David F. 07560
*Glacial geology*
Wrangell Mountains, Miocene-Pliocene: Denton, George H. 07238
*Maps, geologic*
Cosmos Hills area: Fritts, Crawford E. 07279
McCarthy quadrangle, Skolai Group: Smith, James G. 00214

**Alaska—Continued**

*Maps, structure*
South-central, deformation from 1964 earthquake: Plafker, George. 07155
*Mineralogy*
Laurite, Goodnews Bay, mineragraphy, composition: Leonard, B. F. 07191
*Paleontology*
Foraminifera, Permian, Delta River area, biostratigraphy: Petocz, Ronald George. 07336
Palynomorphs, Cretaceous, Upper, new sp.: Tschudy, Bernadine D. 07158
*Petrology*
Kruzof Island, Edgecumbe Volcanics: Brew, David A. 07603
*Sedimentary petrology*
Wrangell Mountains, Chitistone, Nizina Limestones: Armstrong, Augustus K. 07722
*Stratigraphy*
Paleozoic-Mesozoic, Saint Lawrence Island: Patton, William W., Jr. 07615
Permian(?), Rampart Group, central: Brosge, W. P. 07721
Permian, Skolai Group, McCarthy quadrangle: Smith, James G. 00214
*Structural geology*
South-central, tectonics, thrust fault: Plafker, George. 07155

**Alberta**
*Stratigraphy*
Mississippian, Banff and Exshaw Fms., Wabamun Lake area: Martin, H. L. 07599
Pleistocene, glacial drift, Canmore-Calgary areas, method: Rutter, N. W. 07132
*Structural geology*
Central, trends, spatial filtering study: Robinson, J. E. 07591

**Algae**
*Pennsylvanian*
United States, midcontinent, Leavenworth Ls.: Toomey, Donald Francis. 07239
*Tolypella*
Pleistocene, morphology, evolution, cf. living charophytes: Daily, Fay Kenoyer. 07145

**Amphibia**
*Cretaceous*
Montana, Hell Creek Fm., cf. Lance fauna: Estes, Richard. 07286

**Angiosperms**
*Araliaceae*
Eocene, taxonomy: Dolph, G. E. 07150
*Dendropanax*
Eocene, taxonomy: Dolph, G. E. 07150

**Anthozoa**
*Morphology*
Scleractinian, skeletal surface features, electron microscopy: Wise, Sherwood W., Jr. 07552

**Appalachians**
*Absolute age*
Northern, schist, Rb-Sr, K-Ar: Zen, E-an. 07583
*Geomorphology*
Plateau uplands, topographic basins, evolution: Coates, Donald R. 00146
*Maps, isopach*
Salina Group, Appalachian-Michigan basin: Rickard, Lawrence V. 07108
*Maps, lithofacies*
Salina Group, Appalachian-Michigan basins: Rickard, Lawrence V. 07108
*Petrology*
Alpine-type ultramafics, genesis: Carpenter, John R. 07563

**Appalachians—Continued**
*Petrology*—Continued
Northern, metamorphism, episodes: Zen, E-an. 07583
Southeastern, Piedmont intrusive rocks: Butler, J. Robert. 07310
*Sedimentary petrology*
Central, Antietam Fm., sedimentation, environment: Schwab, Frederic L. 07484
Southern, Ordovician, color origin, environments: Thompson, Allan M. 07522
*Stratigraphy*
Cambrian, basin history: Webb, E. J. 07113
Silurian, Salina Group, northern basin, correlation, Michigan basin: Rickard, Lawrence V. 07108
*Structural geology*
Basin, fault systems: Webb, E. J. 07113
North-western, ultramafic rocks, intrusive age: Stevens, R. K. 07507
Southeastern, Piedmont, evolution related to plutons: Butler, J. Robert. 07310

**Arctic**
*Geophysical surveys*
Permafrost, lower boundary, well-temperature logging: Jessop, A. M. 00093

**Arizona**
*Absolute age*
Gila County, Precambrian igneous rocks, Rb-Sr.: Livingston, Donald E. 07418
*Areal geology*
Grand Canyon: Powell, John Wesley. 07171
*Economic geology*
Uranium, Garnet Ridge, genesis: Gavasci, Anna Teresa. 07326
*Geophysical surveys*
Tombstone, Walnut Gulch experimental watershed, hydrogeology: Spangler, Daniel Patrick. 07352
*Hydrogeology*
Phoenix area, Salt River bed, recharge by waste water, experimental study: Bouwer, Herman. 00084
*Petrology*
Tonalea area, tuff clast: Wright, James C. 07616
*Stratigraphy*
Mesozoic, Mule and Huachuca Mts.: Hayes, Philip T. 00135
Pliocene, tuff, Tonalea area, correlation, Bidahochi Fm.: Wright, James C. 07616

**Arkansas**
*Sedimentary petrology*
Ouachita Mountains, Johns Valley Fm., boulders, sedimentation: Shideler, Gerald L. 07489
Ouachita Mountains, Stanley-Jackforth Fms., lithofacies: Morris, Robert C. 07729

**Associations**
*American Association of Petroleum Geologists*
Symposium, computer applications to petroleum exploration: Merriam, Daniel F. 07587
*Geochemical Society*
International Meeting on Organic Geochemistry, 1968: Schenck, P. A. 07207
*International Upper Mantle Committee*
Upper Mantle Project, papers: Hart, Pembroke J. 07755
*Mineralogical Society of America*
Founding and early years: Phair, George. 07193

**Atlantic Coastal Plain**
*Geochemistry*
Saline environments, interstitial waters, chemical changes: Friedman, Gerald M. 00156

**Atlantic Coastal Plain—Continued**
*Paleontology*
Vertebrata, Cenozoic, biostratigraphy, paleoecology: Whitmore, Frank C., Jr. 07542
**Atlantic Ocean**
*Absolute age*
Mid-Atlantic Ridge, fission-track: Aumento, F. 07302
*General*
Genesis, popular account: Hansen, L. Taylor. 07168
*Geomorphology*
Delaware Bay mouth, sediment transport rates, suspended: Oostdam, B. L. 00173
*Geophysical observations*
Gravity field, anomalies, source: Talwani, Manik. 07079
*Geophysical surveys*
Magnetic, anomalies, patterns, relation to tectonics: Heirtzler, J. R. 07085
New York shelf, seismic: Garrison, Louis E. 00100
North, western, gravity: Rabinowitz, Philip D. 07459
Sohm Abyssal Plain, diapirs, seismic: Watson, Jerry A. 00083
*Sedimentary petrology*
Mid-Atlantic Ridge, ferro-manganese deposition, rates: Aumento, F. 07302
North, sedimentary ridges, sedimentation: Johnson, G. Leonard. 07391
Wilkinson basin, sediments, physical properties: Richards, Adrian F. 00177
*Stratigraphy*
Miocene-Holocene, Blake Plateau, outer margin: Kaneps, Ansis G. 07396
Tertiary, Florida continental margin: Charm, W. B. 07157
*Structural geology*
Crustal model, seismic: Ewing, John. 07104
**Automatic data processing**
*Applications*
Earth science: Merriam, Daniel F. 07588
*Bibliography*
Index systems: Smith, Harriet W. 00124
*Correlation*
Ambiguity and similarity functions, computer calculation: Neidell, Norman S. 07592
*Economic geology*
Petroleum exploration, applications, symposium: Merriam, Daniel F. 07587
Petroleum exploration, hydrocarbon distribution in rocks: Davis, John C. 07593
Petroleum exploration, Markov forecasting techniques: Lea, Graham. 07589
Petroleum exploration, subsurface data analysis: Lewis, James O. 07594
*General*
Earth sciences literature, GIPSY system, application: Moody, D. W. 07687
*Geochemistry*
Clay soils, heteroionic, multiple ion diffusivity, computer programs: Brown, D. A. 07267
*Hydrogeology*
Ground-water levels, surface-trend analysis: Davis, L. G. 07274
Regional water conservation, dynamic programming: Aron, Gert. 07314
*Paleontology*
Information structure: Sanders, Robert B. 07478
**Automatic data processing—Continued**
*Sedimentary petrology*
Paleoenvironmental determination, sand grains: Margolis, Stanley V. 07429
*Sedimentary structures*
Crossbedding, rotation to original position, computer program: Parks, James M. 00107
*Statistical methods*
Cluster analysis, CLUSTAN I, FORTRAN II program library: Wishart, David. 07586
Distribution analysis, count-data fitting, FORTRAN IV program: Ondrick, Charles W. 07584
Trend-surface analysis, mapping technique: Cole, A. J. 07585
*Stratigraphy*
Multivariate facies maps: Parks, James M. 07590
*Structural geology*
Structural trends, mapping, spatial filtering: Robinson, J. E. 07591
*Systems analysis*
Multidisciplinary ecosystem model: Park, Richard A. 07715
*X-ray diffraction analysis*
Powder pattern file, aids for use: Hanawalt, J. H. 07249
**Bahamas**
*Maps, geologic*
Great Bahama Bank, Andros Island Platform, multivariate facies maps: Parks, James M. 07590
*Sedimentary petrology*
Grapestone grains, Holocene, genesis: Winland, H. Dale. 07547
*Structural geology*
Subsidence, sea-floor spreading episodes, relations: Lynts, George W. 07575
**Barbados**
*Sedimentary petrology*
Carbonate reefs, diagenesis, porosity changes: Pingitore, Nicholas E., Jr. 07637
**Basins, structural**
*Evolution*
Pennsylvania, Triassic basin: Faill, Rodger T. 07570
*Virginia*
Culpeper basin: Yewisiak, Paul P., Jr. 00190
**Batholiths**
*Alaska*
Coast Range batholith, absolute age: Forbes, Robert B. 00201
*California*
Mesozoic, intrusive epochs, absolute age: Evernden, J. F. 00208
Sierra Nevada, central, chemical variation patterns: Bateman, P. C. 00211
*Granitic*
Orogenic setting, origin, emplacement: Simonen, Ahti. 07069
*Montana*
Boulder batholith, copper dispersion: Al-Hashimi, Abdul Razak K. 07324
*Nevada*
Mesozoic, intrusive epochs, absolute age: Evernden, J. F. 00208
**Bauxite**
*Georgia*
East-central, genesis: Scrudato, Ronald J. 07486

**Bibliography**
*Authors*
Brockamps, Bernhard, polar research: Weiken, Karl. 07261
Hall, Eugene Raymond: Durrant, Stephen D. 07236
*Comprehensive*
List, selected: Smith, Harriet W. 00124
*Ground water*
Recharge, artificial, 1955-67: Signor, D. C. 00077
*Indexing systems*
Computer technique: Smith, Harriet W. 00124
*New York*
Ground-water resources, through 1967: MacNish, Robert D. 07242
*Ohio*
1961-65: Smyth, Pauline. 07225
**Biogeochemistry**
*Textbooks*
Microbial: Zajic, James E. 07175
**Biography**
*Brockamp, Bernhard*: Thyssen, F. 07262
*Brockamps, Bernhard*
Bibliography, polar research: Weiken, Karl. 07261
*Merritt, Neal R.*: Indiana Academy of Science. 07148
*Powell, John Wesley*
Diary of Grand Canyon trip, 1869: Powell, John Wesley. 07171
**Brachiopoda**
*Ordovician*
Northern Hemisphere, Middle, Whiterock stage, faunal correlation: Ross, Reuben James, Jr. 00210
**Breccia**
*Volcanic*
Pipes, genesis: Richard, Kenyon. 07466
**Brines**
*Geochemistry*
Chloride, equilibria: Lerman, Abraham. 07415
**British Columbia**
*Economic geology*
Molybdenum, Hudson Bay Mountain: Jonson, David C. 07394
Polymetallic ores, Hudson Bay Range, zoning, genesis: Kirkham, Rodney Victor. 07329
*Geochemistry*
Bluebell mine, fluid inclusions, composition: Ohmoto, Hiroshi. 07705
*Glacial geology*
Interior Plateau, southern, glacial lake history: Fulton, Robert J. 07127
Volumetric changes in glaciers, 1964-66: Campbell, P. I. 07121
*Maps, geomorphologic*
Interior Plateau, southern, ice retreat and glacial lakes: Fulton, Robert J. 07127
*Petrology*
Kwoiek area, metamorphism: Hollister, Lincoln S. 07134
Thor-Odin gneiss dome, metamorphism: Moore, John M., Jr. 07689
**Bromine**
*Analysis*
Neutron activation, terrestrial, extraterrestrial material: Lieberman, Kenneth Warren. 07312
**Bryozoa**
*Geochemistry*
Ca, Mg, Sr, P distributions, skeletons: Schopf, T. J. M. 07482
**California**
*Absolute age*
Coast Ranges, magnetic anomalies, volcanics, age relations: Yeats, Robert S. 07556
Mesozoic granitic rocks, intrusive epochs: Evernden, J. F. 00208
Mono Basin, lacustrine sediments, C-14: Lajoie, Kenneth R. 07634
*Earthquakes*
Central, SH motion, near distances: Filson, John Roy. 07371
*Economic geology*
Petroleum, Los Angeles and Ventura basins, genesis: Philippi, George Theodor. 07208
*Engineering geology*
Landslides, Middle Fork Eel River: Huffman, Michael E. 07382
*General*
Los Angeles County Museum of Natural History, mineral collections: Lowe, Barbara V. 07657
*Geochemistry*
Boron area, borax deposit, sulfide minerals: Raab, Werner Joseph. 07337
Sierra Nevada batholith, central, composition, variations, patterns: Bateman, P. C. 00211
Visalia area, Rocky Hill stock, trace elements, variations: Putman, George W. 07110
*Geomorphology*
Blue Creek, transport, large particles: Helley, E. J. 07156
Mojave Desert, Dumont sand dunes, genesis: MacDonald, Angus A. 00126
*Geophysical surveys*
Casa Diablo geothermal area, remote sensing: Steller, David D. 07506
Coast Ranges, Salinian block, granitic rocks, heat production: Dodge, F. C. W. 07566
*Maps, geologic*
Coalinga anticline area: Adegoke, Oluwafayisola S. 07284
Mesozoic granitic rocks, distribution: Evernden, J. F. 00208
Reef Ridge area: Adegoke, Oluwafayisola S. 07284
*Mineralogy*
Deerite, howieite, zussmanite, Laytonville area, Franciscan fm.: Borner, Udo. 07115
Hydrous sodium silicates, Trinity County, magadiite deposit: Gude, Arthur J., 3d. 07357
Kornelite, Coso Hot Springs, new occurrence: Weber, Dwight. 00125
*Paleoclimatology*
Quaternary, Searles Lake, salt crystallization temperatures: Smith, George I. 07495
*Paleontology*
Ecosystem, Pleistocene, Irvington biota: Gordon, Wesley D. 07179
Invertebrata, Neogene, Coalinga area, zones, correlation, descriptions: Adegoke, Oluwafayisola S. 07284
Mammalia, Pleistocene, Palm Spring Fm., new bat: White, John A. 07235
Pelecypoda, Jurassic-Cretaceous, biostratigraphy: Jones, D. L. 07760

**California—Continued**
*Petrology*
Amador County, pillow lava, genesis: Duffield, Wendell A. 07604
Red Mountain, ultramafics, magnetic properties, serpentinization: Saad, Afif Hani. 07268
Siberia, Dish Hill craters, ultramafic inclusions, hornblende-bearing: Wilshire, H. G. 07643
Visalia area, Rocky Hill stock and associated rocks: Putman, George W. 07110
*Sedimentary petrology*
Kettleman Hills, Pliocene, cyclic marine sedimentation: Stanton, Robert J., Jr. 07504
Lake Tahoe, Pleistocene sedimentation: Hyne, Norman J. 07384
Mono Basin, Pleistocene sedimentation, rates: Lajoie, Kenneth R. 07634
Rancho Santa Fe area, Lusardi conglomerate: Nordstrom, Charles E. 00204
Ventura Basin, Sespe Fm., environments: McCracken, Willard A. 07434
*Stratigraphy*
Cretaceous, Lusardi Fm., Rancho Santa Fe area: Nordstrom, Charles E. 00204
Death Valley, Titus and Titanothere Canyons area: Reynolds, Mitchell William. 07370
Jurassic-Cretaceous, Colyear Springs-Paskenta area: Jones, D. L. 07760
Jurrasic-Holocene, Coast Ranges: Oakeshott, Gordon B. 00216
Miocene-Pliocene, Coalinga area: Adegoke, Oluwafayisola S. 07284
*Structural geology*
Burro Mountain, peridotite body: Loney, Robert A. 07419
Coast Range, tectonic history: Oakeshott, Gordon B. 00216
Death Valley region, Amargosa chaos, basin-range relations: Wright, Lauren A. 07554
Death Valley, Titus and Titanothere Canyons area: Reynolds, Mitchell William. 07370
Southeastern, Blue Cut fault: Hope, Roger A. 07612
**Cambrian**
*Appalachians*
Basin, stratigraphy, structure: Webb, E. J. 07113
Central, Antietam Fm., sedimentation: Schwab, Frederic L. 07484
*Ontario*
Algoma District, Townships 31-30, Ranges 20-19, Jacobsville Sandstone(?): Ayres, L. D. 07240
*Virginia*
Austinville, Fossil Point Limestone: Balsam, William L. 00140
Harpers Fm., sedimentation: Schwab, Frederic L. 00180
**Canada**
*Economic geology*
Uranium, exploration, techniques, sequence: Little, H. W. 07664
*Hydrogeology*
Western, formation waters, genesis, movement: Hitchon, Brian. 07142
*Structural geology*
Rocky Mountains, tectonics, gravity sliding: Price, Raymond A. 07579
**Carbon**
*Isotopes*
Analysis, methods, water, carbonate species extraction: Gleason, Jim D. 07628
**Carboniferous**
*Arkansas*
Ouachita Mountains, Johns Valley Fm., sedimentation: Shideler, Gerald L. 07489
*Crinoidea*
Acrocrinidae, taxonomy, evolution: Moore, Raymond C. 07738
*Oklahoma*
Ouachita Mountains, Johns Valley Fm., sedimentation: Shideler, Gerald L. 07489
**Caribbean region**
*Paleoclimatology*
Pliocene-Pleistocene boundary, foraminiferal datums: Lamb, James L. 07574
*Structural geology*
Guadeloupe region, island arc evolution: Fink, Lloyd Kenneth, Jr. 07355
**Caves**
*Detection*
Microwave radiometric measurements questioned: Richer, Kenneth A. 00202
*Evolution*
Badland areas: Clausen, E. N. 07359
*Pennsylvania*
Orientation, relation to fracture patterns: Deike, Ruth G. 07304
**Cenozoic**
*Alaska*
Pliocene-Pleistocene boundary, glaciation basis not feasible: Denton, George H. 07238
*Atlantic Coastal Plain*
Vertebrata, biostratigraphy, paleoecology: Whitmore, Frank C., Jr. 07542
*Colorado*
San Juan, Elk Mountains regions, igneous activity: Lipman, Peter W. 07606
*Correlation*
Protista, calcareous nannofossils, worldwide zonation, n. spp.: Bukry, David. 07681
*Epoch boundaries*
Planktonic events, paleotemperature cycles: Bandy, Orville L. 07641
*Florida*
Gastropoda, lucinid taxonomy, *Miltha*: Vokes, Harold E. 07679
*Gulf of Mexico*
Northern, Pleistocene stratigraphy, continental slope: Lehner, Peter. 07306
*Nevada*
Esmeralda County, Silver Peak region, stratigraphy: Moiola, Richard James. 07334
*North America*
Mammalia, Pliocene-Holocene, extinction-origination equilibria: Webb, S. David. 07167
*Pacific Ocean*
Northeastern, Foraminifera, biostratigraphy: Olsson, Richard K. 07707
*Stage boundaries*
Deep-sea sediments, late: Saito, Tsunemasa. 07642
*Wyoming*
Yellowstone Park, Heart Lake Conglomerate, Pliocene(?), Pleistocene(?): Love, J. D. 07613
**Central America**
*Stratigraphy*
Marble belts, interpretation: Kesler, Stephen E. 07402
*Structural geology*
Marble belts, interpretation: Kesler, Stephen E. 07402

**Ceramic materials**
*Pennsylvania*
Greene County, clays, analyses: Roen, John B. 07735
Western, Mercer fireclay, genesis: Bragonier, William A. 00143
**Changes of level**
*Florida*
Holocene, eustatic vs. relative, botanical criteria: Rosenberg, Gary, D. 00212
Pleistocene, sea level, Cape Kennedy area: Osmond, J. K. 00089
*Quaternary*
Sea levels, shelf-edge carbonates, climates, anomalies: Sanders, John E. 00178
*United States*
Eastern coast, Cretaceous-Pleistocene regressions: Garrison, Louis E. 00100
**Chemical analysis**
*Wet*
Mercury, natural waters: Hinkle, Margaret E. 07629
**Chromite**
*Genesis*
Precambrian rocks, podiform deposits: Thayer, T. P. 07518
**Cirripedia**
*Acrothoracica*
Carboniferous-Holocene, taxonomic review, morphology, ecology: Tomlinson, Jack T. 07280
*Simonizapfes davenporti*, n.sp.
Cretaceous, New Jersey, Middletown, acrothoracican: Tomlinson, Jack T. 07280
**Clay mineralogy**
*Areal studies*
Hawaii, volcanic ash soils, allophane, properties: Lai, Sung-ho. 07648
Louisiana, Mississippi River, South Pass, sediments: Ho, Clara L. 07143
Mexico, Rio Ameca, offshore region, geochemistry: Russell, Kenneth L. 07474
Pennsylvania, Monroe County: Epstein, Jack B. 07610
United States, southeastern, continental shelf, sedimentation: Pevear, D. R. 07446
Wisconsin, west-central, soils, mineral translocation, albic tongue formation: Ranney, Richard W. 07731
*Experimental studies*
Al-hydroxide polymorphs, synthesis, structure: Schoen, Robert. 07480
Bentonite, entropies of exchange, alkali metal cations, standard heats: Gast, R. G. 07645
Biotite, weathering, iron oxidation, arid and humid regions: Ismail, F. T. 07202
Clay soils, electrochemical alteration with Al: Gray, D. H. 07265
Clay-water system, changes with depth, temperature, time: Weaver, Charles E. 07537
Exchange capacity, vermiculites and soils, deferration effect: Roth, C. B. 07263
Kaolinite, transformation to metakaolin, interlayer spacings: Mitra, G. B. 07199
Layering phenomena, sedimentation in colloidal suspensions: Merchant, S. R. 07266
Montmorillonite, diagenetic alteration to illite: Pollard, Charles O., Jr. 07452
Montmorillonites, cation exchange, organic molecules and carbonyls: Doner, H. E. 07264
**Clay mineralogy—Continued**
*Experimental studies*—Continued
Soils, radionuclide retention, Panama: Goldsmith, William Alee. 07322
Vermiculite, genesis, weathering of mica: Weed, S. B. 07646
X-ray diffraction analysis, mounting on ceramic tile: Rich, C. I. 07734
*Methods*
Clay mixtures, separation, electrophoretic: Park, Robert G. 07748
*Mineral data*
Montmorillonite, swelling characteristics, effect of interlayering: Kidder, Gerald. 07223
**Clays**
*Experimental studies*
Heteroionic soil systems, multiple ion diffusion, calculation method: Brown, D. A. 07267
*Georgia*
East-central, genesis: Scrudato, Ronald J. 07486
*Kentucky*
Flemingsburg quadrangle, occurrence: Peck, John H. 07219
*Pennsylvania*
Monroe County, occurrence: Epstein, Jack B. 07610
**Coal**
*Classification*
Rank, petrographic approach: Ting, Francis T. C. 07524
*Geochemistry*
Metamorphism, benzene ring fragmentation, laser mass spectrometry: Given, Peter H. 07212
Methane formation: Kim, Ann G. 00165
*Washington*
Cumberland, Hobart, Maple Valley quadrangles, resources: Vine, James D. 07720
**Collections**
*Fossils*
Smithsonian-U.S. Geol. Survey, methods, evaluation: Yochelson, Ellis L. 07744
*Minerals*
California, Los Angeles County Museum Nat. History: Lowe, Barbara V. 07657
*Vertebrata*
Interpretation, Cenozoic vs. pre-Cenozoic records: Hotton, Nicholas, 3d. 07676
**Colorado**
*Absolute age*
Chaffee County, Oligocene volcanic rocks, K-Ar: VanAlstine, R. E. 07719
San Juan Mountains, Ute Creek melasyenite: Barker, Fred. 00133
*Areal geology*
Needle Mountains, Precambrian history: Barker, Fred. 07718
*Economic geology*
Fluorspar, Poncha Springs NE quadrangle: VanAlstine, Ralph E. 07595
*Geochemistry*
Grand Valley area, Green River oil shales, acid extraction: Burlingame, A. L. 07209
Ute Creek melasyenite, analyses, Sr isotopes: Barker, Fred. 00133
*Maps, geologic*
Front Range, northeastern, generalized: Braddock, William A. 00203
Poncha Springs NE quadrangle: VanAlstine, R. E. 07719

**Colorado—Continued**
*Petrology*
San Juan, Elk Mountains regions, Cenozoic volcanics, comparison: Lipman, Peter W. 07606
San Juan Mountains, Ute Creek melasyenite stock: Barker, Fred. 00133
*Stratigraphy*
Poncha Springs NE quadrangle: VanAlstine, R. E. 07719
*Structural geology*
Front Range, Big Thompson anticline, fold mechanics: LeMasurier, Wesley E. 00104
Front Range, metasediments, slaty cleavage genesis: Braddock, William A. 00203
**Concretions**
*Composition*
Iron and manganese content, X-ray fluorescence determination: Barnhisel, R. I. 07733
**Connecticut**
*Geomorphology*
Norfolk area, Blackberry River, drainage changes, Pleistocene: Warren, Charles R. 07624
**Conodonts**
*Devonian*
Indiana, north-central, Traverse Fm.: Orr, R. William. 07144
*Pennsylvanian*
Ohio, Pottsville rocks, biostratigraphy: Merrill, Glen K. 07440
**Construction materials**
*Illinois*
Alton area, Saint Louis Limestone, evaluation as aggregate: Baxter, James W. 07282
*Ohio*
Architectural aggregate, properties, testing: Stith, David A. 07232
*Pennsylvania*
Greene County, shale, analyses: Roen, John B. 07735
*Properties*
Weathering in urban atmospheres, salt burst in stone: Winkler, E. M. 00111
**Continental drift**
*Causes*
Mantle convection, nonsteady-state: Knopoff, Leon. 07160
Mantle convection, questioned: Lyustikh, E. N. 07161
*Crustal structure*
Magnetic anomalies, Pacific Ocean off Baja California: Chase, C. G. 00209
*General*
Laurasia, history: Hurley, Patrick M. 07383
*Mechanism*
Sea-floor spreading evidence, continental margin, N. America cf. Africa: Rona, Peter A. 00101
*Paleoclimatology*
Application, conflicting evidence, review: Meyerhoff, A. A. 00094
*Paleomagnetism*
Application, conflicting evidence, review: Meyerhoff, A. A. 00094
Sea-floor spreading, magnetic reversal stratigraphy: Vine, F. J. 07534
Supporting evidence: Heirtzler, J. R. 07085
*Paleontology*
Foraminifera, Tertiary, distribution, Caribbean region: Phillips, J. D. 07448
**Continental drift—Continued**
*United States*
Evidence, sediment volumes, off conterminous: Gilluly, James. 00102
**Continental margin**
*Evolution*
Rift, compressional models: Schneider, Eric D. 07581
*Florida*
Eastern, stratigraphy, JOIDES cores: Charm, W. B. 07157
*General*
Geomorphology and relations to petroleum occurrence: Hedberg, Hollis D. 00199
Structure, tectonics, Atlantic cf. Pacific: Drake, Charles L. 07054
*Gulf of Mexico*
Northern, Pleistocene stratigraphy: Lehner, Peter. 07306
*Mexico*
Baja California, structure: Normark, W. R. 07703
*North America*
Eastern, rise, genesis, history: Emery, K. O. 00099
*United States*
Cape Hatteras, cf. northwestern Africa: Rona, Peter A. 00101
Eastern, shallow structure, genesis: Uchupi, Elazar. 00136
New York, shelf, genesis: Garrison, Louis E. 00100
Northeastern, shelf, history: Oldale, R. N. 07706
Southeastern, shelf, sediment dispersion, space photos: Stevenson, Robert E. 07508
**Continents**
*Genesis*
Interpretation from Precambrian absolute age data: Kuno, Hisashi. 07064
*Structure*
Rift systems, characteristics: Belousov, V. V. 07052
**Copper**
*Abundance*
Boulder batholith, dispersion, Montana: Al-Hashimi, Abdul Razak K. 07324
**Core**
*Composition*
Silicon, meteoritic evidence: Wai, Chien M. 07182
**Correlation**
*Methods*
Ambiguity and similarity functions, computer calculation: Neidell, Norman S. 07592
**Cratering**
*Experimental studies*
Transient water craters, energy balance: Olevson, K. L. R. 07622
*Field studies*
Arizona, Flagstaff area: Bailey, N. G. 07621
*Theoretical studies*
High-velocity-impact, energy partitioning: Turner, Gerry H. 07356
**Cretaceous**
*Alaska*
Colville and Nation Rivers areas, Upper, palynomorphs: Tschudy, Bernadine D. 07158
*California*
Coast Ranges, stratigraphy: Oakeshott, Gordon B. 00216

**Cretaceous – Continued**
*California – Continued*
Rancho Santa Fe area, Lusardi Fm.: Nordstrom, Charles E. 00204
Sacramento Valley, Colyear Springs-Paskenta area, biostratigraphy: Jones, D. L. 07760
*Montana*
Pisces, Hell Creek Fm., new amioid?, albulid: Estes, Richard. 07285
Vertebrata, lower, Hell Creek Fm., cf. Lance fauna: Estes, Richard. 07286
*Nevada*
Pine Valley quadrangle, Ostracoda: Sohn, I. G. 07759
*New Jersey*
Cretaceous-Tertiary datum, biostratigraphy: Olsson, Richard K. 00172
Middletown, Cirripedia, Upper, acrothoracican, n.sp.: Tomlinson, Jack T. 07280
*Palynomorphs*
Geographic distribution, N. Am., Soviet Union: Stanley, E. A. 00184
*Puerto Rico*
Northwestern, stratigraphy: McIntyre, David H. 00131
*Texas*
Western, sedimentation, carbonate spit-channel couplet: Moore, Clyde H., Jr. 07688
*United States*
Ostracoda, Cenomanian deposits, index fossil: Hazel, Joseph E. 07618
Western Interior basin, marine cycles: Kauffman, Erle G. 07237
*World*
Paleontological break: Reso, Anthony. 07463
*Wyoming*
Hanna, Carbon Basins, sedimentation: Ryan, J. Donald. 07638
Pisces, Lance Fm., new albulid: Estes, Richard. 07285
**Crinoidea**
*Acrocrinidae*
Carboniferous, taxonomy, new subfamilies, genera, spp.: Moore, Raymond C. 07738
Carboniferous, United States, central, taxonomy, evolution: Moore, Raymond C. 07738
**Crust**
*Atlantic Ocean*
Seismic model: Ewing, John. 07104
*Composition*
Granitic and basaltic shells: Ronov, A. B. 07089
Primitive, interpretation of Precambrian basement petrology: Mehnert, K. R. 07063
*Deformation*
Continental, tectonic movements, types: Khain, V. E. 07051
Recent movements, isostatic compensation: Artyushkov, E. V. 07082
*Experimental studies*
Mineral phase transitions, review: Ringwood, A. E. 07058
*Exploration*
Seismic methods, major results: Ritsema, A. R. 07095
*General*
Upper Mantle Project, papers: Hart, Pembroke J. 07755
*Genesis*
Differentiation of mantle material: Ringwood, A. E. 07087
Granitic and basaltic shells, mantle differentiation: Ronov, A. B. 07089
**Crust – Continued**
*Genesis – Continued*
Isotope geochemistry evidence: Hart, Stanley R. 07090
Role of catastrophic events: Zenger, Donald H. 00119
*Heat flow*
Relation to age of tectonic activity: Lubimova, E. A. 07091
*Oceanic*
Composition, structure, genesis, model analyses: Vogt, Peter R. 07055
*Physical properties*
Conducting structure, magnetotelluric studies: Madden, T. R. 07067
Density, gravity value standardization, effect: Woollard, George P. 07076
*Structure*
Interpretation from magnetic data: Ostenso, Ned A. 07065
North America, seismic data, interpretation: Healy, John H. 07103
Types, relation to mantle types, surface wave data: Brune, James N. 07105
**Crustacea**
*Pennsylvanian*
Evolution: Schram, Frederick R. 07483
**Cryptoexplosion structures**
*Kansas*
Winkler Crater, *not* meteorite crater: Brookins, Douglas G. 00108
*Quebec*
Manicouagan structure, contact metamorphism: Murtaugh, John G. 07691
**Crystal chemistry**
*Apatite*
Phosphate ores: McClellan, Guerry H. 07196
*Chalcopyrite*
Interfacial reactions: McGlashan, D. W. 07165
*Silicate minerals*
Bonding, X-ray emission spectroscopy: Dodd, Charles G. 07188
**Crystal structure**
*Analysis*
Teaching, Tinker Toy models: Buseck, Peter R. 00122
*Chalcopyrite*
Properties, interfacial reactions: McGlashan, D. W. 07165
*Classification*
$R^{III}OOH$ compounds, natural, synthetic: Milton, Charles. 07577
*Humite*
Mg-Fe ordering: Ribbe, P. H. 07465
*Laueite and pseudolaueite*
Not true polymorphs: Baur, Werner H. 07189
*Plumboferrite*
Variations: Kohn, J. A. 07408
*Sulfide minerals*
Principles: Pauling, Linus. 07716
*Sulfosalts*: Nowacki, W. 07704
**Crystallography**
*Methods*
Teaching, Tinker Toy models: Buseck, Peter R. 00122
**Cuba**
*Geomorphology*
Western, offshore bottom features, processes: Zenkovich, V. P. 07737
**Deformation**
*Experimental studies*
Mechanism, creep, stored energy, graphite: Green, W. V. 00091

**Deformation—Continued**
*Experimental studies*—Continued
Methods, rock, apparatus, experiments: Donath, Fred A. 00123
Moduli, Young's, compressibility, rocks: Al-Sinawi, Sahil Abdulla. 07346
*Field studies*
Failure, prediction on slopes, microseismic method: Wisecarver, David W. 07164
Mechanism, twin-gliding, limestone folding, New York: Spang, John H. 07499
Techniques, zero frequency seismology: Press, Frank. 07100
*Theoretical studies*
Mechanism, plastic flow, ultramafic minerals: Raleigh, C. B. 07460
**Delaware**
*Areal geology*
New mapping, Delaware Geological Survey: Pickett, Thomas E. 00174
**Devonian**
*Indiana*
North-central, Traverse Fm., conodonts: Orr, R. William. 07144
*Nevada*
Central, Silurian boundary, graptolite zone marker: Berry, William B. N. 00217
*North America*
Midcontinent, sand distribution patterns and geologic history: Summerson, C. H. 00218
*Pennsylvania*
Northeastern, Catskill Fm.: Glaeser, J. Douglas. 00157
*Saskatchewan*
Winnipegosis Fm., laminar anhydrite: Shearman, D. J. 07363
**Diagenesis**
*Anhydrite*
Calcitization, Saskatchewan, Winnipegosis Fm.: Shearman, D. J. 07363
*Carbonate rocks*
Fluorite-bearing, Oregon, Malheur County: Sheppard, Richard A. 07608
*Cementation*
Carbonate, experimental study: Schmalz, Robert F. 00179
*Clay*
Kaolinitization, Georgia: Scrudato, Ronald J. 07486
*Montmorillonite*
Alteration to illite: Pollard, Charles O., Jr. 07452
*Reef carbonates*
Cementation, Barbados: Pingitore, Nicholas E., Jr. 07637
*Sandstone*
Appalachians, Oswego Fm., red-green color boundary: Horowitz, Daniel H. 07376
**Diapirs**
*Gulf of Mexico*
Campeche shelf and slope, salt domes, seismic study: Ballard, J. Alan. 00105
**Differential thermal analysis**
*Allophane*
High-alumina: Snetsinger, Kenneth G. 07204
*Lead sulfantimonides*
Drafall, Larry E. 07568
*Hydrobasaluminite*
Indiana: Sunderman, Jack A. 07195
**Earth**
*Elasticity*
Free vibrations, normal modes: Dahlen, Francis Anthony, Jr. 07349

**Earth—Continued**
*General*
Textbook, advanced students: Stacey, Frank D. 07178
*History*
Catastrophic events, role in crust development: Zenger, Donald H. 00119
*Interior*
Crust-mantle interrelations, review: Belousov, V. V. 07163
Crust-mantle transition, review of studies: McKenzie, D. P. 07758
Equations of state at high pressure: Zharkov, V. N. 07059
Experimental studies, mineral phase transitions, review: Ringwood, A. E. 07058
Mass distributions, satellite data: Woollard, George P. 00213
Structure, higher modes of surface waves: Alterman, Z. 07072
*Origin*
Popular account: Haber, Heinz. 07176
*Shape*
Hydrostatic models, gravity anomalies, satellite data: Khan, M. A. 07077
Standardization of gravity measurements, effect: Woollard, George P. 07076
*Temperature*
Heat production vs. heat flow, significance of iron core: Lubimova, E. A. 07091
**Earthquakes**
*Alaska*
March 28, 1964, deformation: Plafker, George. 07155
*California*
Central, SH motion, near distances: Filson, John Roy. 07371
*Classification*
Depth ranges: Miyamura, Setumi. 07096
*Effects*
Major disasters, casualties, potential dangers: Latter, J. H. 07116
*Elastic waves*
Attenuation, mantle, dimensionless specific factor: Knopoff, Leon. 07073
Surface waves, higher modes, Earth structure: Alterman, Z. 07072
*Engineering*
Simulation, random processes: Levy, Roy. 07318
*General*
Relation to surface structures: Petrushevsky, B. A. 07075
*Hawaii*
1968, epicenters, magnitudes: Koyanagi, Robert Y. 07620
*Hypocenters*
Determination, higher modes of surface waves: Alterman, Z. 07072
*Magnitude*
Energy release, cf. nuclear explosions: Tocher, Don. 00128
Energy release, relations: Hadley, James W. 00127
*Mechanism*
Focal models: Stevens, Anne E. 07099
Relation to long-term displacements, strains, tilts: Press, Frank. 07100
*Oceanic areas*
Midoceanic ridge system, relation to tectonics: Sykes, Lynn R. 07098

**Earthquakes—Continued**
*Prediction*
Crustal deformation, microseisms, magnetic field changes: Hagiwara, Takahiro. 07101
Key observations, control prospects: Press, Frank. 07458
*Trigger*
Nuclear explosions, BENHAM event: Smith, Stewart W. 07358
*Worldwide*
Seismicity, review: Miyamura, Setumi. 07096
**Ecology**
*California*
Santa Barbara Basin, planktonic shell preservation: Berger, Wolfgang H. 00085
*Crinoidea*
Marine, Caribbean Sea, cf. Mississippian forms: Meyer, David L. 07683
*Foraminifera*
Benthonic Caribbean Sea, shelf sediments: Seiglie, George A. 07746
*New Hampshire*
Estuarine, Great Bay, sediments, biogenic disturbance: Winstonk, Judith E. 07549
**Economic geology**
*Methods*
Classification, sulfide deposits: Sawkins, Frederick J. 07479
Sampling, ore deposits: Koch, George S., Jr. 07407
**Education**
*Curricula*
Interdisciplinary honors seminar, geology, biology: Weis, Leonard W. 07283
Secondary schools, earth science, decrease and increase: Orgren, James R. 07227
*Earth science*
Curriculum, secondary, ESCP instructional material, research on results: Champlin, Robert F. 00121
Methods, inquiry, open-ended: Lueck, Gail G. 00120
*Engineering geology*
Urban development, curricula, Indiana University: Wayne, William J. 07149
*General*
Earth science teachers, Indiana, secondary schools: Boneham, Roger F. 07761
ESCP program, team effort concept, evaluation: Kutner, Philip. 07412
Methods, summer institutes in earth science for teachers: Anderson, Norman D. 07229
Ohio, teacher-training program, earth science: Roth, Robert A. 07228
Secondary, depositional system concept: Johnson, Kenneth G. 07392
Superior studies students, second course: Menzer, Fred J., Jr. 07438
Syracuse University, laboratory courses, introductory: Romey, William D. 07230
*Geology*
Teaching, graduate school, research incompatibility concept, error: Hatfield, Craig B. 00118
*Geomorphology*
Coastal environment, Univ. of Washington courses: Sternberg, Richard W. 07107
*Methods*
Closed-circuit television, teaching assistant training: Romey, William D. 07469
Individualized instruction: Staley, Richard M. 07502
**Education—Continued**
*Structural geology*
Dynamic, rock deformation apparatus and experiments: Donath, Fred A. 00123
**El Salvador**
*Geochemistry*
Ahuachapan geothermal area, exploration, extent of self-sealing: Facca, G. 07307
*Geophysical surveys*
Ahuachapan geothermal area, exploration, extent of self-sealing: Facca, G. 07307
**Elastic properties**
*Rocks*
Wave velocities, attenuation: Al-Sinawi, Sahil Abdulla. 07346
**Electrical methods**
*Instruments*
Transducer, soil salinity, in situ determination: Enfield, C. G. 07732
*Interpretation*
Resistivity sounding data, Wenner electrode system: Chan, Siew Hung. 07347
**Electrical properties**
*Rocks*
Parameters, linear system analogy: Fuller, Brent D. 00082
*Sulfide materials*
General: Pickart, Stanley J. 07449
**Electron microscopy**
*Applications*
Paleoenvironmental determination, sand grains: Margolis, Stanley V. 07429
Sediments, environments, differentiation: Lyall, Anil. 07423
*Data*
Corals, microstructure, dissepiments: Sorauf, James E. 07498
Corals, scleractinian, skeletal surface features: Wise, Sherwood W., Jr. 07552
Diamond, dodecahedral faces, ruts and ridges, triangular depressions: Patel, A. R. 07190
Sand, abrasion, turbidity current transport: Margolis, Stanley V. 07576
**Engineering geology**
*Applications*
New York, Niagara Falls preservation: Wilkinson, Thomas A. 07543
*Dams*
Kentucky, Cumberland River, Wolf Creek Dam: Simmons, Marvin D. 07493
*Earthquakes*
Earth structures, non-linear response: Dibaj, Mostafa. 07369
Simulation, random processes: Levy, Roy. 07318
*Education*
Curricula, urban development, Indiana University: Wayne, William J. 07149
*Environmental geology*
West Virginia, planning program: Wilson, Peter G. 00189
*Experimental studies*
Clay soils, electrochemical alteration with Al: Gray, D. H. 07265
Stress-wave propagation, sand: Wetzel, Richard Allen. 07319
*Foundations*
Elastic waves, in situ measurement: Holt, Richard J. 07373
Mexico, Mexico City area: Marsal, Raul J. 07753

**Engineering geology—Continued**
*Foundations*—Continued
Peat, response to plate loading, field studies: LoPinto, Victor J. 00086
Soil, framed structures interaction, mechanical modelanalysis: Dominick, Wayne Paul. 07316
*Gas storage*
Porous medium, diffusion, theoretical, field data: Robertson, John B. 07630
Pressure-monitoring system, subsurface: Kunkler, J. L. 07726
*Geologic hazards*
Earthquakes, volcanic eruptions, general: Latter, J. H. 07116
Recognition, improved characterization: Jahns, Richard H. 07632
South Dakota, Rapid City West quadrangle: Cattermole, J. Mark. 07217
*Land use*
Planning, coordinated soils and geology mapping: McComas, Murray R. 07277
*Landslides*
California, Middle Fork Eel River: Huffman, Michael E. 07382
Pennsylvania, highway construction: Flint, Norman K. 00154
*Materials, properties*
Building stone, weathering in urban atmosphere: Winkler, E. M. 00111
Velocity-stress studies: Seegmiller, Ben Lorin. 07321
*Permafrost*
Arctic, oil exploration, heat flow, permafrost base: Jessop, A. M. 00093
*Rock mechanics*
Techniques, in-situ stress determination: Becker, Robert M. 07166
*Slope stability*
Open-pit mines, failure prediction, microseismic technique: Wisecarver, David W. 07164
*Soils*
Fine-grained, consolidation, mathematical model: Hall, Kenneth McCoy. 07317
Indiana, northwestern, power transmission line: West, Terry R. 07540
Mexico, Mexico City area: Marsal, Raul J. 07753
Seismic responses, sloping base rocks, effects: Dezfulian, Houshang. 07315
Silty, moisture transfer upon freezing, function of porosity: Jumikis, Alfreds R. 07747
Till deposits: White, George W. 07541
*Urban development*
Environmental problems, research, education, practice: Wayne, William J. 07149
*Waste disposal*
Ground-water recharge design: Bouwer, Herman. 00084
Sites, selection criteria: Emrich, Grover H. 00150
**Erosion**
*Glaciers*
Cirques, formation by floor deepening: White, William A. 00098
*New York*
Niagara Falls, rate: Philbrick, Shailer S. 07447
*Streams*
Channels, transformation of pools, riffles to meanders: Tinkler, Keith J. 00109
*United States*
Phanerozoic, sedimentary volumes, significance: Gilluly, James. 00102
**Estuaries**
*Sedimentation*
Gulf of Saint Lawrence, suspended matter: d'Anglejan, B. F. 07362
**Evaporites**
*Atlantic Ocean*
Abyssal plains, possible formation in proto-Atlantic: Watson, Jerry A. 00083
*United States*
Silurian, Salina Group, Appalachian and Michigan basins, deposition: Rickard, Lawrence V. 07108
**Evolution**
*Algae*
Charophytes, Quaternary: Daily, Fay Kenoyer. 07145
*Biotic provinces*
Paleozoic, late: Ross, Charles A. 07473
*Concepts*
Cretaceous, major paleontological break: Reso, Anthony. 07463
Darwin's theory, development, analysis of method: Ghiselin, Michael T. 07743
Darwin's theory, development, present status: Simpson, George Gaylord. 07662
Entropy, factor analysis: Sadlick, Walter. 07477
*Crinoidea*
Acrocrinidae, Mississippian-Pennsylvanian: Moore, Raymond C. 07738
*Crustacea*
Pennsylvanian, Synarida: Schram, Frederick R. 07483
*Mammalia*
*Docodon*, Jurassic, molar occlusion: Jenkins, Farish A., Jr. 07653
Mesonychid condylarths, Paleocene, feeding mechanism: Szalay, Frederick S. 07368
Pliocene-Holocene, North America, extinction-origination equilibria: Webb, S. David. 07167
*Processes*
Chemical, life origin, primitive Earth, experimental: Lemmon, Richard M. 00079
Natural selection as stabilizing factor: Simpson, George Gaylord. 07662
*Vertebrata*
Textbook: Colbert, Edwin H. 07366
**Explosion phenomena**
*Experimental studies*
Shock-wave propagation, elastic-plastic media: Nakano, Yoshisuke. 07658
**Faults**
*Basin range*
California, Death Valley, Amargosa chaos, genetic relations: Wright, Lauren A. 07554
*Detachment*
Mechanism, volcanic gas role, Wyoming, Heart Mtn. fault: Hughes, Charles J. 00198
Mechanism, volcanic gas role, Wyoming, Heart Mtn. fault: Hughes, Charles J. 00205
Mechanism, volcanic gas role, Wyoming, Heart Mtn. fault: Pierce, William G. 00097
*General*
Newfoundland, Belle Bay, Precambrian-Paleozoic contact: Williams, Harold. 00188
Pennsylvania, anthracite area, Catskill-Pocono contact: Hoskins, Donald M. 00163
*Mechanism*
Upthrusts: Lowell, James D. 07421
*Normal*
California, Coast Ranges, major zones: Oakeshott, Gordon B. 00216

**Faults – Continued**
*Overthrust*
Alaska, Cosmos Hills, southeastern: Fritts, Crawford E. 07279
Alaska, south-central: Plafker, George. 07155
New York, New Jersey, Pennsylvania, Port Jervis fault: Soren, Julian. 00183
Oregon, Dothan-Rogue Fms., contact: Hotz, Preston E. 07614
*Rift valleys*
Continental, characteristics: Belousov, V. V. 07052
*Strike-slip*
California, Coast Ranges, major zones: Oakeshott, Gordon B. 00216
California, southeastern, Blue Cut fault: Hope, Roger A. 07612
New Brunswick, north-central, Catamaran fault: Anderson, F. D. 00138
Worldwide, characteristics, tabulation: Wellman, H. W. 07053
*Systems*
Appalachian basin: Webb, E. J. 07113
Montana, genesis of disturbed belt, northwestern: Mudge, Melville R. 00103
New York, Ramapo fault, Rosetown pluton, relation: Ratcliffe, Nicholas M. 00176
**Florida**
*Absolute age*
Cape Kennedy, barrier-lagoon complex, shells, beach rock: Osmond, J. K. 00089
Everglades, upper, peat profile: McDowell, L. L. 07644
*Economic geology*
Petroleum, West Florida Platform, possibilities: Winston, George O. 07272
*Geochemistry*
Northern, Floridan aquifer waters, U-isotope disequilibrium: Kaufman, M. I. 07126
Northern, ground water, uranium isotopes: Rydell, Harold Stanford. 07340
*Geomorphology*
Florida Keys, buried karst, sedimentation: Siemers, Charles T. 07490
Seagrove Beach, topography, systematic changes: vanBeek, Johannes L. 07529
Sea-level changes, eustatic vs. relative, botanical criteria: Rosenberg, Gary, D. 00212
*Hydrogeology*
Ground-water levels, 1965-66: Healy, Henry G. 00081
Northern, Floridan aquifer, U-isotope study: Kaufman, M. I. 07126
Tarpon Springs, carbonate aquifers, fresh-water, salt-water relations: Stringfield, V. T. 07111
*Paleontology*
Pelecypoda, Cenozoic, lucinid taxonomy: Vokes, Harold E. 07679
Pelecypoda, Miocene, Chipola Fm., lucinid, n. sp.: Vokes, Harold E. 07680
**Fluid inclusions**
*Composition*
British Columbia, Bluebell mine: Ohmoto, Hiroshi. 07705
**Fluorspar**
*Colorado*
Browns Canyon district, genesis: VanAlstine, R. E. 07719
Poncha Springs NE quadrangle, occurrence, production: VanAlstine, Ralph E. 07595
**Fluorspar – Continued**
*Oregon*
Malheur County, occurrence: Sheppard, Richard A. 07608
**Folds**
*Anticlinal*
New England, Quebec, Second Lake anticline: Harwood, David S. 07611
*Mechanism*
Calcite, twinning strain studies, New York: Spang, John H. 07499
Colorado, Front Range, Big Thompson anticline: LeMasurier, Wesley E. 00104
*Nomenclature*
Multiple fold areas, phases, geographic names useful: Tobisch, Othmar T. 07640
*Recumbent*
Newfoundland, Burlington Peninsula, Fleur de Lys Supergroup: Coates, H. J. 00147
South Carolina, Walhalla area: Griffin, Villard S., Jr. 07305
*Theoretical studies*
Pennsylvania, Allegheny plateau, wavelengths, model: Sherwin, Jo-Ann. 00182
**Foliation**
*Genesis*
Slaty cleavage, Colorado, metasediments: Braddock, William A. 00203
**Foraminifera**
*Fusulinidae*
Pennsylvanian, Nevada, Bird Spring Fm., Mtn. Springs Pass area: Marshall, Frederick C. 07117
*General*
Sessile forms, diastem indicators: Kilbourne, Richard T. 07403
*Geographic distribution*
Tertiary, Caribbean region, continental drift: Phillips, J. D. 07448
*Glaucoamminia trilateralis*, n. gen., n. comb.
Holocene, Caribbean Sea, ecology, glauconite in test: Seiglie, George A. 07746
*Morphology*
Wall structures, biofacies determination: Buchanan, Hugh. 00144
*Permian*
Alaska, Delta River area, biostratigraphy: Petocz, Ronald George. 07336
*Quaternary*
California, Santa Barbara Basin, shell preservation: Berger, Wolfgang H. 00085
*Reophax caribensis*, n. sp.
Holocene, Caribbean Sea, comparative taxonomy, ecology: Seiglie, George A. 07746
*Triticites cullomensis*
Pennsylvanian, Kansas, Lecompton Fm., variation analysis: Koepnick, Richard B. 07633
**Fractures**
*Experimental studies*
Frequency and apertures in undisturbed rocks: Snow, D. T. 00194
*Patterns*
Determination from solution passages: Deike, Ruth G. 07304
New Mexico, Questa molybdenum deposit: Rehrig, William Allen. 07339
*Systems*
New York, Staten Island serpentinite: Miller, William H. 00169
**Gas, natural**
*Oklahoma*
Panhandle, occurrence: Moore, Carl A. 07214

**Gas, natural—Continued**
*Pennsylvania*
Developments, 1968: Kelley, Dana R. 07650
*Production*
Reservoir stimulation by nuclear explosions: Johansen, Robert T. 07125
*United States*
Composition, analyses: Cardwell, L. E. 00078
**Gastropoda**
*Metoptomatidae*
Systematics: MacClintock, Copeland 07424
*Symmetrocapulidae*
Systematics: MacClintock, Copeland 07424
**Gems**
*General*
Inclusions, nature, research, gem genesis: Gubelin, E. 07287
**General**
*Catalogs*
Samples, cores, logs, index, Utah: Fox, R. Chris. 07221
*Education*
Curriculum, secondary, ESCP instructional material, research on results: Champlin, Robert F. 00121
Interdisciplinary honors seminar, geology, biology: Weis, Leonard W. 07283
Methods, inquiry, open-ended: Lueck, Gail G. 00120
Ohio, teacher-training program, earth science: Roth, Robert A. 07228
Secondary schools, earth science, decrease and increase: Orgren, James R. 07227
Summer institutes in earth science for teachers, North Carolina: Anderson, Norman D. 07229
Syracuse University, laboratory courses, introductory: Romey, William D. 07230
*Philosophy*
Darwinian scientific method: Ghiselin, Michael T. 07743
Environment, control on evolution: Dodge, Charles F. 07231
Major discoveries, developments, past 5 years: Pecora, W. T. 07717
*Practice*
Automatic data processing, applications: Merriam, Daniel F. 07588
Responsibility to relate geology to culture: Dodge, Charles F. 07231
Teaching, graduate school, research incompatibility concept, error: Hatfield, Craig B. 00118
*Textbooks*
Chemistry in introductory geology: Keller, W. D. 07170
Historical geology: Dunbar, Carl O. 07172
Laboratory manual, elementary course: Barksdale, Julian D. 07173
Physics of the Earth, advanced students: Stacey, Frank D. 07178
**Geochemical methods**
*Geochemical logging*
Well-bore cuttings, petroleum exploration: Feugere, G. 00195
**Geochemical prospecting**
*Black shale*
Metals, element associations, statistical analysis: Vine, James D. 07597
*Fluorescence*
Remote sensing technique, ore deposits: Monroe, John N. 07250
*Suspended solids technique*
Copper, East Tennessee: Perhac, Ralph M. 07441
**Geochemical surveys**
*El Salvador*
Ahuachapan geothermal area, extent of self-sealing: Facca, G. 07307
*Wyoming*
Hydrocarbon distribution in Mowry Shale, relation to oil fields: Davis, John C. 07593
**Geochemistry**
*Abundance of elements*
Coefficient of variation: Koch, George S., Jr. 07407
*Brines*
Chloride, equilibria: Lerman, Abraham. 07415
*Carbonates*
Genesis, role of proteins: Mitterer, Richard M. 07685
*Coal*
Metamorphism, benzene ring fragmentation, laser mass spectrometry: Given, Peter H. 07212
*Exchange capacity*
Clay soils, heteroionic, quick-freeze calculation, computer programs: Brown, D. A. 07267
Montmorillonites, organic cations and carbonyls, hydrogen bonding: Doner, H. E. 07264
Vermiculites and soils, deferration effect: Roth, C. B. 07263
*Fossil plants*
Devonian-Permian species, carbohydrate components, analysis: Swain, Frederick M. 07750
*Hydrocarbons*
Diffusion in water, effects of salt concentration, experiments: Bonoli, Luciano. 07211
*Iron*
Movement in aqueous vapor phase: Martin, R. F. 07430
*Oil shale*
Green River Formation, carboxylic acids, experimental study: Burlingame, A. L. 07209
*Organic*
Life, origin: VanHoeven, William, Jr. 07313
*Organic analytical data*
Interpretation: Oro, J. 07711
*Organic materials*
International meeting, 1968, proceedings: Schenck, P. A. 07207
*Processes*
Cation exchange, entropies, heats, Wyoming bentonite: Gast, R. G. 07645
*Solubility*
Calcium carbonate in seawater: Hawley, J. 07185
*Textbooks*
Marine chemistry: Horne, R. A. 07174
Microbial biogeochemistry: Zajic, James E. 07175
**Geochronology**
*Ferro-manganese deposition rate*
Mid-Atlantic Ridge chronology: Aumento, F. 07302
**Geodesy**
*Figure of Earth*
Geoidal highs and lows, satellite data analysis: Woollard, George P. 00213
Gravity measurement standardization, effect: Woollard, George P. 07076
Hydrostatic models, mass anomalies, satellite data: Khan, M. A. 07077
**Geological exploration**
*Methods*
Remote sensing, side-looking radar, mapping: Holmes, Robert F. 07137

**Geological exploration—Continued**
*Methods*—Continued
Rock and ore identification, activation analysis, field equipment: Tolmie, R. W. 07672
**Geomorphology**
*Environment*
Coastal, general, Univ. of Washington courses: Sternberg, Richard W. 07107
*Eolian features*
Dunes, Mojave Desert, California, Dumont area, genesis: MacDonald, Angus A. 00126
*Estuarine features*
Transport, suspended matter, Gulf of St. Lawrence: d'Anglejan, B. F. 07362
*Fluvial features*
Alluvial channel bedforms, ground-water microflow system effects: Harrison, Samuel S. 07303
James River drainage basin, Pleistocene history, Virginia: Spencer, R. S. 00087
Pools, riffles, transformation to meanders: Tinkler, Keith J. 00109
Rivers, channel geometry, metamorphosis: Chitale, Shrikrishna V. 00113
Stream channels, alluvial, ripple concentrations, friction factor: Chang, Fred F. M. 00115
Stream channels, bedforms, flume-width effect: Crickmore, Maurice J. 00116
Stream channels, open, dunes and antidunes on erodible bed, genesis: Hayashi, Taizo. 00114
Terraces, Nevada, Pyramid Lake area: Ritter, Dale F. 07468
Transport, large particles, California, Blue Creek: Helley, E. J. 07156
Transport, silt, deposition in gravel bed: Einstein, H. A. 00112
Valleys, buried, Pennsylvania, Slippery Rock, Muddy Creeks: Szucs, F. K. 00186
Waterfall, New York, Niagara Falls, erosion: Philbrick, Shailer S. 07447
*Glacial features*
Cirques, formation by floor erosion: White, William A. 00098
Erratics, Kentucky, northeastern, pre-Illinoian: Ray, Louis L. 07623
General, Maine, northwestern: Borns, Harold W., Jr. 00141
Moraines, Yukon, Saint Elias Mts., chronology: Denton, George H. 07361
*Landform evolution*
Appalachian Plateau uplands, topographic basins: Coates, Donald R. 00146
Connecticut, Norfolk area, drainage changes: Warren, Charles R. 07624
New England, differential weathering and erosion: Rahn, Perry H. 00175
Northwest Territories, Devon Island, periglaciation effects: King, Roger Hatton. 07323
Washington, Mount Rainier National Park: Crandell, Dwight R. 07181
*Marine features*
Cuba, western offshore bottom features, processes: Zenkovich, V. P. 07737
Submarine canyons, Hawaii, Molokai: Mathewson, Christopher C. 07432
*Methods*
Regionalization, morphometric units: Lewis, Laurence A. 07146
*Periglacial features*
Hummocks, Northwest Territories, Arctic Archipelago, terrace slopes: Habrich, Wulf. 07259

**Geomorphology—Continued**
*Quantitative geomorphology*
Landforms, regionalization of units, Indiana: Lewis, Laurence A. 07146
Streams, bifuricaton ratios: Flint, Jean-Jacques. 00153
Valleys, proportions: Palmquist, Robert C. 07713
*Shore features*
Barrier islands, evolution: Pierce, J. W. 07450
Beaches, Massachusetts, New Hampshire, storm effects: Hayes, Miles O. 00162
Capes, shoals, United States, southeastern: Hoyt, John H. 07378
Estuary, Rhode Island, Narragansett Bay, structural control: Fisher, John J. 00151
General, Florida, systematic changes: vanBeek, Johannes L. 07529
Inlets, migration, sedimentation, New York: Kumar, Naresh. 00166
Raised shorelines, botanical markers: Rosenberg, Gary, D. 00212
Transport, sedimentation, barrier bar-lagoon complex: Dillon, William P. 00096
*Solution features*
Caves, evolution, badland areas: Clausen, E. N. 07359
Karst, buried, Florida, Florida Keys: Siemers, Charles T. 07490
**Geophysical surveys**
*Arizona*
Tombstone, Walnut Gulch experimental watershed: Spangler, Daniel Patrick. 07352
*El Salvador*
Ahuachapan geothermal area, extent of self-sealing: Facca, G. 07307
*Worldwide*
Activity 1968, mining, summary: Hood, Peter J. 07270
Activity 1968, summary: Allen, J. S. 07271
**Geophysics**
*Textbooks*
Solid-earth geophysics, advanced students: Stacey, Frank D. 07178
**Georgia**
*Economic geology*
Clays, east-central: Scrudato, Ronald J. 07486
**Geosynclines**
*Cordilleran*
Continental margin, evolution: Roberts, Ralph J. 07580
*Sedimentation*
Appalachian-Ouachita salients, clastic wedges, tectonics: Thomas, William A. 07521
**Geothermal energy**
*El Salvador*
Ahuachapan area, self-sealing field, geophysical studies: Facca, G. 07307
**Glaciation**
*Ice movements*
Till fabrics, interpretation: Harris, Stuart A. 07677
**Glaciers**
*British Columbia*
Sentinel, Sphinx, Nadahini, Kokanee, Bugaboo Glaciers, volume changes: Campbell, P. I. 07121
*Greenland*
Icecap, heat budget: Ambach, W. 07260
Icecap, west-east profile, altitudes, 1959 and 1968: Seckel, Hansjorg. 07258

**Gold**
*Abundance*
Igneous rocks, magmatic differentiation: Gottfried, David. 07572
*Alaska*
Cosmos Hills, southeastern, placer deposits: Fritts, Crawford E. 07279
*Analysis*
Activation, radiochemical separation, amalgam exchange: Ruch, R. R. 07243
X-ray fluorescence, semiconductor detectors: Burkhalter, P. G. 07669
*Maryland*
Montgomery County, Great Falls area, occurrence: Reed, J. C., Jr. 07596
**Graptolithina**
*Devonian*
Nevada, Lower, zoning, correlation: Berry, William B. N. 00217
**Gravel**
*Illinois*
Macon County, occurrence: Hester, Norman C. 07122
**Gravity field, Earth**
*Atlantic Ocean*
Anomalies, source: Talwani, Manik. 07079
*Interpretation*
Standardization of absolute measurements: Woollard, George P. 07076
*United States*
Regional variations, topographic effect: Woollard, George P. 07078
*Variations*
Mass anomalies, satellite perturbation data: Khan, M. A. 07077
Relation to geologic and geophysical parameter variations: Strange, W. E. 07123
Satellite-tracking data, geoidal highs and lows: Woollard, George P. 00213
**Gravity methods**
*Interpretation*
Anomalies, Alaska, continental margins, lack of isostatic adjustment: Barnes, David F. 07560
California-Oregon offshore areas, anomalies, sources: Dehlinger, Peter. 07080
Volcanic regions, Hawaiian Ridge, Japan: Malahoff, Alexander. 07081
**Gravity surveys**
*Atlantic Ocean*
Northwestern: Rabinowitz, Philip D. 07459
*California*
Tulare County, Rocky Hill stock: Putman, George W. 07110
*New Hampshire*
Southeastern, Exeter pluton: Bothner, Wallace A. 00142
*New York*
Regional: Revetta, Frank A. 07464
*Pennsylvania*
Eastern: Revetta, Frank A. 07464
**Great Lakes region**
*Sedimentary petrology*
Lake Erie, sand, minerals, settling velocity distributions: Lowright, R. H. 00167
**Greenland**
*Geochemistry*
Kangerdlugssuaq area, fjord waters, element distribution, sources: Berthois, L. 07736
*Geophysical surveys*
Ilimaussaq intrusion, radioactivity, technique: Lovborg, L. 07740
**Greenland – Continued**
*Glacial geology*
Icecap, heat budget: Ambach, W. 07260
Icecap, west-east profile, altitudes, 1959 and 1968: Seckel, Hansjorg. 07258
*Petrology*
Ilimaussaq intrusion, nepheline syenites, rhythmic layering: Sorensen, Henning. 07109
*Sedimentary petrology*
Icecap, microparticle deposition, distribution: Hamilton, Wayne L. 07655
Kangerdlugssuaq fjord, sediments: Berthois, L. 07736
**Ground water**
*Arizona*
Recharge, Phoenix area, waste-water renovation, experimental study: Bouwer, Herman. 00084
*Florida*
Fresh-water, salt-water equilibrium, carbonate aquifers, coastal: Stringfield, V. T. 07111
Geochemistry, Floridan aquifer, U-isotope disequilibrium: Kaufman, M. I. 07126
Levels, 1965-66: Healy, Henry G. 00081
*Indiana*
Model studies, trend-surface and analog, Bartholomew County: Davis, L. G. 07274
*Minnesota*
Resources, southwestern, Yellow Medicine River watershed: Novitzki, R. P. 07233
*Nevada*
Movement, Great Basin, eastern, deuterium tracer: Winograd, Isaac J. 07548
Recharge, Humboldt River valley: Harsh, John Franklin. 07327
*New Mexico*
Movement, Roswell artesian basin: Maddox, George Edward. 07332
*New York*
Recharge, treated sewage water, Long Island: Vecchioli, John. 07532
*Oklahoma*
Movement, Ozark region, springs: Bingham, Roy H. 07275
*Ontario*
Movement, temperature, Cochrane area: Parsons, Myles Lyle. 07335
*Saskatchewan*
Movement, recharge, Good Spirit Lake drainage basin: Freeze, R. A. 07278
*Utah*
Quality, Great Basin, deterioration: Handy, A. H. 07626
**Guatemala**
*Absolute age*
Southeastern, Chiquimula pluton, Rb-Sr: Long, Leon E. 07420
**Gulf Coastal Plain**
*Paleontology*
Protista, Eocene, calcareous nannofossils, n. spp., correlation: Bukry, David. 07681
**Gulf of California**
*Sedimentary petrology*
Sonora area, sand waves, tidal currents: Marzolf, John E. 07431
**Gulf of Mexico**
*Economic geology*
Petroleum, possibilities, deep-water areas: Walker, Jack R. 07273
Petroleum, West Florida Platform, possibilities: Winston, George O. 07272

**Gulf of Mexico—Continued**
*Geochemistry*
Continental shelf, bottom sediments, trace elements: Holmes, Charles W. 07136
*Geophysical surveys*
Campeche shelf and slope, salt domes, seismic: Ballard, J. Alan. 00105
Deep water areas, seismic: Walker, Jack R. 07273
Northern, continental slope, seismic: Lehner, Peter. 07306
*Paleoclimatology*
Pleistocene, cycles, foraminifera: Beard, John H. 07561
*Sedimentary petrology*
Abyssal plain sediments, shear strength measurements: Richards, Adrian F. 07467
Deep-sea cores, sediment data and interpretation: Beall, Arthur O. 07114
Mississippi cone, sediments, sedimentation: Huang, T. C. 07379
*Stratigraphy*
Pleistocene, northern continental shelf: Lehner, Peter. 07306
*Structural geology*
Northern continental shelf, faults, salt tectonics: Lehner, Peter. 07306
Southern, tectonics: Weidie, A. E. 07538
**Gulf of Saint Lawrence**
*Geomorphology*
Sediment transport, suspended matter: d'Anglejan, B. F. 07362
*Sedimentary petrology*
Sediments, suspended matter: d'Anglejan, B. F. 07362
**Gypsum**
*United States*
Midwestern, resources: Cleveland, John H. 07152
**Hawaii**
*Earthquakes*
1968, epicenters, magnitudes: Koyanagi, Robert Y. 07620
*Geomorphology*
Molokai, north shore, submarine canyons, evolution: Mathewson, Christopher C. 07432
*Mineralogy*
Allophane, volcanic ash soils, chemical properties: Lai, Sung-ho. 07648
*Sedimentary petrology*
Soils, volcanic ash source, properties: Lai, Sung-ho. 07648
*Volcanology*
Mauna Loa, Sulphur Cone, sulfur flow: Skinner, Brian J. 00129
**Heat flow**
*California*
Coast Ranges, Salinian block, granitic rocks: Dodge, F. C. W. 07566
*Heat sources*
Anomalous, magmatic activity: Horai, Ki-iti. 07094
*Interpretation*
Earth, history: Lubimova, E. A. 07091
*Northwest Territories*
Mackenzie delta, Reindeer well, data: Jessop, A. M. 00093
*Regional patterns*
North America: Simmons, Gene. 07092
Oceanic: VonHerzen, R. P. 07093
**Heat flow—Continued**
*Volcanic areas*
Mechanism, penetrative mantle convection: Horai, Ki-iti. 07094
**Heavy minerals**
*Virginia*
Roseland district, rutile-ilmenite placers: Herz, Norman. 00215
**Helium**
*General*
Discovery, origin, properties, isotopes: Zimmerman, Joan. 00080
*Oklahoma*
Panhandle, source, trapping mechanism: Moore, Carl A. 07214
*United States*
Resources, content in natural gas: Cardwell, L. E. 00078
**History**
*American Mineralogist*
1916-1919: Phair, George. 07192
*Mineralogical Society of America*
Founding and early years: Phair, George. 07193
*Natural disasters*
Earthquakes, volcanic eruptions, classification by casualty effects: Latter, J. H. 07116
**Hydrogen**
*Isotopes*
Deuterium, ultramafic rocks, serpentinization: Wenner, David B. 07539
**Hydrogeology**
*Aquifer properties*
Aquifer-aquitards, permeabilities, evaluation: Witherspoon, P. A. 07553
Transmissibility trends, Maryland, coastal plain: Hansen, Harry J. 00160
*Automatic data processing*
Aquifer evaluation, New Jersey, Englishtown Fm.: Nichols, William D. 07701
Regional water conservation, dynamic programming: Aron, Gert. 07314
Water-table geometries, trend surface modeling: Turner, A. Keith. 07526
*Bibliography*
Ground-water recharge, artificial, 1955-67: Signor, D. C. 00077
*Experimental studies*
Water-conducting fractures, frequency and apertures: Snow, D. T. 00194
*General*
Advances since 1960: Maxey, George B. 07433
*Geochemistry*
Carbonate species, extraction, carbon-isotope analysis: Gleason, Jim D. 07628
Mercury, determination: Hinkle, Margaret E. 07629
Pennsylvania, Nittany Valley, carbonate saturation: Langmuir, Donald. 07414
Prairie potholes, effects of soil chemistry: Miller, Reuben F. 07725
*Ground-water contamination*
Unsaturated zone, hydraulic conductivity, computation, barometric fluctuations: Stallman, R. W. 07503
*Ground-water movement*
Alluvial channel bedforms, microflow systems: Harrison, Samuel S. 07303
*Ground-water recharge*
Waste-water renovation, design: Bouwer, Herman. 00084

**Hydrogeology—Continued**
*Hydrodynamics*
Canada, western, formation waters: Hitchon, Brian. 07142
*Nomenclature*
Existing confusion, solution: Hubbert, M. King. 07381
*Salt-water intrusion*
Coastal aquifers: Pinder, George F. 07451
Coastal aquifers, carbonate, salt-water, freshwater equilibrium: Stringfield, V. T. 07111
**Hydrothermal alteration**
*Zoning*
Porphyry copper deposits: Rose, Arthur W. 07471
**Idaho**
*Engineering geology*
Gas storage, National Reactor Testing Station, field, theoretical data: Robertson, John B. 07630
*Maps, magnetic*
Mount Pend Oreille quadrangle, airborne: U.S. Geological Survey. 07226
*Petrology*
Craters of the Moon, volcanic series: Stone, George Thomas. 07510
*Structural geology*
Snake River Plain, Quaternary lava domes, distribution: Stone, George Thomas. 07511
**Igneous rocks**
*Andesite*
Genesis, orogenic belts: McBirney, Alexander R. 07061
Geochemistry, V, Ni contents, genetic significance: Osborn, E. F. 07184
Geochemistry, V, Ni contents, genetic significance: Taylor, S. R. 07364
*Basalt*
Genesis, plateau types, mantle melting: Kuno, Hisashi. 07060
Melting, differentiation, upper mantle, magma genesis: Green, D. H. 07070
Paleoflow structures, New Jersey, Newark Basin: Manspeizer, Warren. 07428
*Differentiation*
Montana, Shonkin Sag laccolith, mafic minerals: Nash, William P. 07695
Parent magma from clinopyroxene compositions: Witkind, Irving J. 07309
*Experimental studies*
Devitrification rates in rhyolite glass: Lofgren, Gary. 00110
*Gabbro*
Petrology, Ontario: Naldrett, A. J. 07694
*General*
Absolute age, New England, White Mtn. magma series: Foland, K. A. 00155
Composition, Washington, Okanogan Range: Menzer, Fred J., Jr. 07439
Magnetic properties, Montana, Boulder batholith: Hanna, W. F. 07619
Petrology, Appalachians, southeastern, Piedmont: Butler, J. Robert. 07310
*Geochemistry*
Bromine, fractionation, analysis: Lieberman, Kenneth Warren. 07312
*Granitic*
Absolute age, Guatemala, Chiquimula pluton: Long, Leon E. 07420

**Igneous rocks—Continued**
*Granitic*—Continued
Absolute age, Washington, Okanogan Range: Menzer, Fred J., Jr. 00200
Petrology, Massachusetts, Mansfield quadrangle: Lyons, Paul Christopher. 07331
Textures, New York, Peekskill pluton: Anibal, Espejo C. 00139
*Kimberlite*
General description, Kansas, Riley County, Winkler Crater: Brookins, Douglas G. 00108
Genesis: MacGregor, Ian. 07427
*Mafic*
Petrology, inclusions in basalts: Kuno, Hisashi. 07062
*Melting*
Experimental, granite, quartz monzonite, granodiorite: Piwinskii, A. J. 00095
*Peridotite*
Structure, California, Burro Mtn.: Loney, Robert A. 07419
*Plutonic*
Composition, variations, California, Sierra Nevada batholith: Bateman, P. C. 00211
*Quartz monzonite*
Absolute age, Coast Range batholith, Alaska: Forbes, Robert B. 00201
*Syenite*
Petrology, composition, absolute age, Colorado, Ute Creek stock: Barker, Fred. 00133
Petrology, Greenland, Ilimaussaq intrusion, rhythmic layering: Sorensen, Henning. 07109
*Ultramafic*
Alteration, serpentinization, D, O-18 studies: Wenner, David B. 07539
General, world belts, mantle correlation: Wyllie, Peter J. 07068
Genesis, alpine-type, Appalachians: Carpenter, John R. 07563
Petrology, inclusions in basalts: Kuno, Hisashi. 07062
Petrology, Nevada, xenoliths in basalt: Trask, Newell J. 07607
*Volcanics*
General description, Cretaceous-Tertiary series, Puerto Rico: McIntyre, David H. 00131
Petrology, absolute age, Oregon, Newberry Caldera: Higgins, Michael W. 07605
Petrology, Arizona, Tonalea area, tuff: Wright, James C. 07616
Petrology, Colorado, San Juan and Elk Mts. regions: Lipman, Peter W. 07606
Petrology, geochemistry, Alaska, Kruzof Island: Brew, David A. 07603
Petrology, Idaho, Craters of the Moon: Stone, George Thomas. 07510
Pillow structure, California, genesis: Duffield, Wendell A. 07604
**Illinois**
*Economic geology*
Construction materials, Alton area, St. Louis Limestone, aggregate: Baxter, James W. 07282
Gravel, Macon County, occurrence: Hester, Norman C. 07122
*Geophysical surveys*
Chicago area, radioactivity: Flint, George M., Jr. 00193
*Maps, mineral resources*
Macon County, sand and gravel: Hester, Norman C. 07122

**Illinois – Continued**
*Maps, radioactivity*
Chicago area, airborne: Flint, George M., Jr. 00193
**Impact phenomena**
*Products*
Fe-Ni spherules in soil: Hodge, Paul W. 00196
**Inclusions**
*Gems*
Identification, genesis: Gubelin, E. 07287
*Mafic-ultramafic*
Basaltic rocks, upper mantle interpretations: Kuno, Hisashi. 07062
*Ultramafic*
California, Siberia, Dish Hill crater, hornblende-bearing: Wilshire, H. G. 07643
Nevada, Nye County, basalt: Trask, Newell J. 07607
**Indiana**
*Areal geology*
Mitchell Plain, surficial: Powell, Richard L. 07154
*Economic geology*
Petroleum, Cincinnati Arch area, possibilities: Patton, John B. 07112
*Engineering geology*
Indiana University, curricula, urban development: Wayne, William J. 07149
Soils, northwestern, power transmission line: West, Terry R. 07540
*General*
Earth science teachers, secondary schools: Boneham, Roger F. 07761
*Geomorphology*
Quantitative geomorphology, regionalization of landform units: Lewis, Laurence A. 07146
*Geophysical surveys*
Chicago (Ill.) area, radioactivity: Flint, George M., Jr. 00193
*Hydrogeology*
Bartholomew County, aquifer, trend-surface analysis cf. analog models: Davis, L. G. 07274
*Maps, radioactivity*
Chicago (Ill.) area, airborne: Flint, George M., Jr. 00193
*Mineralogy*
Hydrobasaluminite, Shoals area, genesis, description: Sunderman, Jack A. 07195
*Paleontology*
Conodonts, Devonian, Traverse Fm., correlation: Orr, R. William. 07144
Flora, Pennsylvanian, coal ball, classification: Judd, Robert W. 07151
*Stratigraphy*
Devonian, Traverse Fm., correlation, Logansport Sag: Orr, R. William. 07144
Pleistocene, drift sequence, Brown County: Schneider, Allan F. 07153
**Infrared methods**
*General*
Compared with low sun-angle photography: Howard, Arthur D. 00106
*Interpretation*
Airborne, igneous rocks: Kilinc, I. A. 07404
**Intrusions**
*Breccia pipes*
Genesis: Richard, Kenyon. 07466
*Diatremes*
Kansas, Winkler Kimberlite, Riley County: Brookins, Douglas G. 00108
Utah, Mule Ear complex, temperature, age: Naeser, C. W. 07692
**Intrusions – Continued**
*General*
California, Burro Mountain, peridotite, structure: Loney, Robert A. 07419
*Laccoliths*
Montana, Shonkin Sag complex, differentiation: Nash, William P. 07695
*Layered*
Petrology, Ontario: Naldrett, A. J. 07694
*Mechanism*
California, Visalia area, Rocky Hill stock: Putman, George W. 07110
Utah, Henry Mountains, concordant, evolution: Pollard, David D. 07453
*Plutons*
Appalachians, southeastern, petrochemical history: Butler, J. Robert. 07310
Guatemala, Chiquimula complex, absolute age: Long, Leon E. 07420
New York, Hudson Highlands, Rosetown complex: Ratcliffe, Nicholas M. 00176
New York, Peekskill pluton: Anibal, Espejo C. 00139
*Structure*
California, Visalia area, Rocky Hill stock: Putman, George W. 07110
**Invertebrata**
*Identification*
Fragments, rock and thin section techniques: Majewske, Otto P. 07180
*Tertiary*
California, Coalinga area, zones, correlation, descriptions: Adegoke, Oluwafayisola S. 07284
**Iron**
*Analysis*
X-ray fluorescence, soils and concretions: Barnhisel, R. I. 07733
**Island arcs**
*Caribbean region*
Lesser Antilles, evolution: Fink, Lloyd Kenneth, Jr. 07355
**Isostasy**
*Compensation*
Postglacial crustal adjustments, mantle movements: Artyushkov, E. V. 07082
*Processes*
Gravity convection: Artyushkov, E. V. 07082
**Isotopes**
*Applications*
Crust-mantle processes: Hart, Stanley R. 07090
*Carbon*
Water, analysis methods, carbonate species extraction: Gleason, Jim D. 07628
*Strontium*
Melasyenite, ratios, Colorado, Ute Creek: Barker, Fred. 00133
Weathering profiles, deep-sea sediments, sedimentary rocks: Dasch, E. Julius. 07183
*Sulfur*
Sphalerite-galena, fractionation, experimental: Rye, Robert O. 07476
Sulfide mineral pairs, fractionation, experimental: Kajiwara, Yoshimichi. 07395
Sulfides, related minerals, ratios: Thode, H. G. 07520
*Tracer experiments*
Ion diffusion, heteroionic soil systems: Brown, D. A. 07267
*Uranium*
Ground water, ratios, Florida: Rydell, Harold Stanford. 07340

**Isotopes—Continued**
*Uranium—Continued*
Ground water, U-234/U-238 disequilibrium, application: Kaufman, M. I. 07126
**Jamaica**
*Economic geology*
Kaolin, occurrence, resources: Versey, H. R. 07674
**Jurassic**
*California*
Coast Ranges, stratigraphy: Oakeshott, Gordon B. 00216
Sacramento Valley, Colyear Springs-Paskenta area, biostratigraphy: Jones, D. L. 07760
*Oregon*
Southwestern, Dothan-Rogue Fms., contact relations: Hotz, Preston E. 07614
**Kansas**
*Economic geology*
Lead-zinc, Picher field: McKnight, Edwin T. 00207
*Mineralogy*
Vivianite, Graneros Shale, earthy, thermal and X-ray studies: Tien, Pei-lin. 07194
*Paleontology*
Ostracoda, mollusca, Pleistocene, Dickinson County, biostratigraphy: Gutentag, Edwin D. 07617
*Petrology*
Riley County, Winkler Kimberlite: Brookins, Douglas G. 00108
**Kaolin**
*Jamaica*
Occurrence, resources: Versey, H. R. 07674
*Mexico*
Resources: Pasquera, R. 07675
**Kentucky**
*Economic geology*
Limestone, Samuels quadrangle: Kepferle, Roy C. 07216
Mineral resources, Flemingsburg quadrangle: Peck, John H. 07219
Mineral resources, Hudgins quadrangle: Miller, Robert C. 07218
Petroleum, Cincinnati Arch area, possibilities: Patton, John B. 07112
Petroleum, Sutherland quadrangle: Johnson, William D., Jr. 07220
*Engineering geology*
Dams, Cumberland River, Wolf Creek Dam: Simmons, Marvin D. 07493
*Glacial geology*
Northeastern, erratics, pre-Illinoian advance: Ray, Louis L. 07623
*Maps, geologic*
Flemingsburg quadrangle: Peck, John H. 07219
Hudgins quadrangle: Miller, Robert C. 07218
Samuels quadrangle: Kepferle, Roy C. 07216
Sutherland quadrangle: Johnson, William D., Jr. 07220
*Sedimentary petrology*
Ashland area, Allegheny rocks, deltaic sequence, lithofacies: Whaley, Peter Walter. 07345
Ohio River sediments, sedimentation rates, coal particles: Moore, Bruce R. 00170
Western, Pennsylvanian, basal, channel complex: Shawe, Fred R. 07625
*Stratigraphy*
Pennsylvanian, Cenozoic, Sutherland quadrangle, section: Johnson, William D., Jr. 07220
**Lake Superior region**
*Mineralogy*
Prehnite, Isle Royale, volcanics: Huber, N. King. 07723
**Lakes**
*California*
Lake Tahoe, Pleistocene sedimentation: Hyne, Norman J. 07384
*Nevada*
Lake Tahoe, Pleistocene sedimentation: Hyne, Norman J. 07384
**Lakes, extinct**
*British Columbia*
Interior Plateau, southern, glacial: Fulton, Robert J. 07127
*Connecticut*
Lake Norfolk: Warren, Charles R. 07624
**Laser methods**
*Instruments*
Airborne pulsed neon laser, nearshore environment: Hickman, G. Daniel. 07139
**Lava**
*Organic materials*
Hawaii, Kilauea, Alae Crater: Hodgson, Gordon W. 07762
**Lead**
*Abundance*
Sea water and polar snow, sources, natural and manmade: Patterson, Clair C. 07248
*Kansas*
Picher field, occurrence, genesis: McKnight, Edwin T. 00207
*New England*
New Hampshire-Maine, occurrence: Cox, Dennis P. 00134
*Oklahoma*
Picher field, occurrence, genesis: McKnight, Edwin T. 00207
**Limestone**
*Illinois*
Alton area, Saint Louis Limestone, aggregate possibilities: Baxter, James W. 07282
*Kentucky*
Flemingsburg quadrangle, occurrence: Peck, John H. 07219
**Lineation**
*Regional*
West Virginia, Burning Springs area, radar imagery: Wing, Richard S. 07546
**Louisiana**
*Geochemistry*
Mississippi, South Pass, sediment core, properties: Ho, Clara L. 07143
**Magmas**
*Differentiation*
Granitic, California, Rocky Hill stock: Putman, George W. 07110
Kimberlite, genesis: MacGregor, Ian. 07427
Montana, Little Belt Mts., crystal settling, pyroxene: Witkind, Irving J. 07309
Ontario, Sudbury: Naldrett, A. J. 07694
Quebec, Monteregian igneous province, gabbroic, syenitic: Philpotts, A. R. 07636
Rhythmic layering, nepheline syenites, Greenland, Ilimaussaq intrusion: Sorensen, Henning. 07109
*Experimental studies*
Basaltic, phase equilibria: Holloway, John R. 07135
*Genesis*
Basaltic: Green, D. H. 07070

**Magmas—Continued**
*Genesis*—Continued
Plateau basalts, mantle melting: Kuno, Hisashi. 07060
**Magnetic field, Earth**
*Interpretation*
Distribution pattern, geologic bodies effect: Nagata, Takesi. 07083
Variation anomalies, conductivity anomalies in mantle: Rikitake, Tsuneji. 07066
**Magnetic methods**
*Interpretation*
Crust and mantle structures, advances: Ostenso, Ned A. 07065
Model, prismatic, magnetic field: Andreasen, Gordon E. 07147
Satellite magnetometer observations, United States, western: Zietz, Isidore. 07558
**Magnetic properties**
*Igneous rocks*
Montana, Boulder batholith: Hanna, W. F. 07619
*Rocks*
Induced and remanent components: Nagata, Takesi. 07083
Remanence, application: Runcorn, S. K. 07757
Types of magnetism, properties of induced and remanent: Verhoogen, John. 07056
*Sulfide materials*
General: Pickart, Stanley J. 07449
*Ultramafic rocks*
Serpentinization effect, California, Red Mtn.: Saad, Afif Hani. 07268
*Volcanic rocks*
Remanence, basaltic cf. andesitic volcanoes: Malahoff, Alexander. 07086
**Magnetic surveys**
*Atlantic Ocean*
Anomalies, relation to tectonics: Heirtzler, J. R. 07085
*Montana*
Boulder batholith, anomalies: Hanna, W. F. 07619
*Pacific Ocean*
Baja California area, tectonic interpretation: Chase, C. G. 00209
Linear anomaly sets, tectonic interpretation: Vacquier, Victor. 07084
*United States*
Crustal studies, review: Ostenso, Ned A. 07065
Midcontinent, possible rift system: King, Elizabeth R. 07405
*Volcanoes*
Anomalies, characteristics: Malahoff, Alexander. 07086
**Magnetotelluric methods**
*Interpretation*
Crust-mantle conductivity structure: Madden, T. R. 07067
**Magnetotelluric surveys**
*United States*
Selected areas: Renick, Howard, Jr. 07351
**Maine**
*Areal geology*
Hancock County, Blue Hill-Castine mining district: Cheney, E. S. 00145
*Economic geology*
Lead-zinc-silver, southwestern, occurrence: Cox, Dennis P. 00134
*Glacial geology*
Northwestern, glaciation, deglaciation history: Borns, Harold W., Jr. 00141
**Maine—Continued**
*Mineralogy*
Feldspar, zoned alkali, Lincoln sill syenite: Elders, Wilfred A. 07569
*Petrology*
Waterville area, pyrrhotite-pyrite isograd: Williamson, Terrance C. 07545
*Structural geology*
Boundary Mountain anticlinorium, Second Lake anticline: Harwood, David S. 07611
Rangeley area, pre-metamorphic tectonics: Moench, Robert H. 07686
**Major-element analyses**
*Clay*
Pelagic, Pacific Ocean, Fe: Cronan, D. S. 07186
Pennsylvania, Monroe County: Epstein, Jack B. 07610
*Igneous rocks*
Washington, Okanogan Range: Menzer, Fred J., Jr. 07439
*Melasyenite*
Colorado, San Juan Mts.: Barker, Fred. 00133
*Quartz monzonite*
Colorado, Chaffee County, Poncha Springs quadrangle: VanAlstine, R. E. 07719
*Shale*
Geochemical standard, Purington Shale: Moore, D. M. 07578
*Volcanics*
Alaska, Kruzof Island, Edgecumbe Volcanics: Brew, David A. 07603
Colorado, Chaffee County, Poncha Springs quadrangle: VanAlstine, R. E. 07719
**Mammalia**
*Anzanycteris anzanensis*, n.gen., n.sp.
Pleistocene, California, Palm Spring Fm., nyctophiline bat: White, John A. 07235
*Cenozoic*
North America, late history, extinction-origination equilibria: Webb, S. David. 07167
*Docodon*
Jurassic, Colorado-Wyoming, Morrison Fm., molar occlusion: Jenkins, Farish A., Jr. 07653
*Mesonychidae*
Paleocene, feeding mechanism, evolution from arctocyonids: Szalay, Frederick S. 07368
*Nyctophilinae*
Cenozoic, taxonomy, comparative morphology: White, John A. 07235
*Odocoileus halli*, n.sp.
Quaternary, Mexico, Tlapacoya area: Alvarez, Ticul. 07234
*Ondatra*
Pleistocene, paleoecology: Nelson, Robert S. 07698
*Quaternary*
Mexico, Tlapacoya area, bone beds: Alvarez, Ticul. 07234
**Manganese**
*Abundance*
Igneous rocks, Montana, Philipsburg batholith: Mohsen, Lotfi Abdel-Fattah M. 07333
*Analysis*
X-ray fluorescence, soils and concretions: Barnhisel, R. I. 07733
*New Jersey*
Sterling Hill, structure: Metsger, Robert W. 07682

**Mantle**
*Composition*
Ultramafic rocks, relations: Wyllie, Peter J. 07555
Upper, mafic-ultramafic inclusions in basalts: Kuno, Hisashi. 07062
Upper, ultramafic, differentiation process: Ringwood, A. E. 07087
*Elastic waves*
Attenuation, dimensionless specific factor, determination: Knopoff, Leon. 07073
P-wave velocity, regional variation, North America: Herrin, Eugene. 07106
Surface waves, phase-velocity dispersion: Dorman, James. 07071
*Evolution*
Strontium isotope ratios, models: Hart, Stanley R. 07090
*Experimental studies*
Basalt-eclogite transition, fine structure: Ito, Keisuke. 07386
Gravitation differentiation energy vs. radiogenic energy: Lubimova, E. A. 07091
Mineral phase transitions, review: Ringwood, A. E. 07058
Petrology, phase equilibria: O'Hara, M. J. 07057
Upper, density and composition, olivine layer: Birch, Francis. 07088
*Exploration*
Seismic methods, major results: Ritsema, A. R. 07095
*General*
Upper Mantle Project, papers: Hart, Pembroke J. 07755
*Low-velocity layer*
Experimental data: Birch, Francis. 07088
*Oceanic*
Models, analysis, relation to crustal genesis: Vogt, Peter R. 07055
*Physical properties*
Anisotropy, off California: Raitt, Russell W. 07756
Conductivity anomalies, interpretation: Rikitake, Tsuneji. 07066
Conductivity structure, magnetotelluric studies: Madden, T. R. 07067
Magnetic, upper: Verhoogen, John. 07056
Phase transitions: Speidel, David H. 07582
*Processes*
Convection, effect on Earth structures: Runcorn, S. K. 07162
Convection, nonsteady-state: Knopoff, Leon. 07160
Convection, problematic: Lyustikh, E. N. 07161
Isotope geochemistry evidence: Hart, Stanley R. 07090
Melting, genesis of basaltic magmas: Green, D. H. 07070
Melting, genesis of plateau basalts: Kuno, Hisashi. 07060
*Structure*
Interpretation from magnetic data: Ostenso, Ned A. 07065
Seismic models: Vaněk, Jiří 07074
Transitional zone, causes: Magnitsky, V. A. 07159

**Marine geology**
*Bottom features*
Atlantic continental margin, United States, genesis: Uchupi, Elazar. 00136

**Marine geology—Continued**
*Bottom features*—Continued
General, off western Cuba: Zenkovich, V. P. 07737
Hawaii, Molokai, submarine canyons: Mathewson, Christopher C. 07432
*Exploration*
Deep Sea Drilling Project, drilling operations: Sims, Darrell L. 07494
Glomar Challenger, Cruise 7, 1969: Winterer, Edward L. 07550
JOIDES Deep Sea Drilling Project, status: Peterson, M. N. A. 07445
*Instruments*
Electron macroprobe, deep-sea cores: Deffeyes, Kenneth S. 07565
*Paleontology*
Calcareous nannofossils, Cenozoic, deep-sea cores, correlation: Bukry, David. 07681
*Research vessels*
GULFREX, exploration program: Driver, Edgar S. 00149
*Sediments*
Abrasion, turbidity current transport, electron microscopy: Margolis, Stanley V. 07576
Environment, differentiation by activation analysis: Santos, G. G. 07742
Transport, oceanic density interfaces: Bouma, Arnold H. 07562
Volumes, Phanerozoic, continental margin, U. S.: Gilluly, James. 00102
*Stratigraphy*
Cenozoic, deep-sea sediments, stage boundaries: Saito, Tsunemasa. 07642
Continental rise, North America: Emery, K. O. 00099
Continental shelf, New York: Garrison, Louis E. 00100
*Structure*
Continental rise, North America, genesis, history: Emery, K. O. 00099

**Maryland**
*Economic geology*
Gold, Montgomery County, Great Falls area: Reed, J. C., Jr. 07596
*Hydrogeology*
Coastal plain, aquifers, transmissibility trends: Hansen, Harry J. 00160
*Paleontology*
Paleocene, Brightseat, Aquia Fms., Potomac River valley, paleoecology: Kauffman, Erle G. 07398

**Massachusetts**
*Geomorphology*
Beaches, storms as modifying agents: Hayes, Miles O. 00162
*Petrology*
Mansfield quadrangle, granitic rocks: Lyons, Paul Christopher. 07331
*Stratigraphy*
Paleozoic, early, western, correlation: Hatch, Norman L. 00161
Worcester area, metasediments, age relations, revision: Grew, Edward S. 00158

**Mercury**
*Analysis*
Chemical, natural waters: Hinkle, Margaret E. 07629
*Geochemistry*
Sea water, sources: Klein, David H. 07247

**Mesozoic**
*Alaska*
Saint Lawrence Island, stratigraphy: Patton, William W., Jr. 07615
*Arizona*
Mule and Huachuca Mts., stratigraphy: Hayes, Philip T. 00135
*California*
Granitic rocks, absolute age: Evernden, J. F. 00208
*Nevada*
Western, granitic rocks, absolute age: Evernden, J. F. 00208
*Northwest Territories*
Ellesmere Island, Yelverton Pass region, stratigraphy: Nassichuk, W. W. 07598
*Utah*
Star Range, stratigraphy: Baetcke, Gustav Berndt. 07325
**Metals**
*Alaska*
Kanuti River region, exploration, occurrence: Patton, William W., Jr. 00130
*Exploration*
Field analysis, activation equipment: Tolmie, R. W. 07672
Instruments, X-ray fluorescence probe, drill-hole: Rhodes, J. R. 07668
Suspended solids technique: Perhac, Ralph M. 07441
*Geochemistry*
Sediments, marine, interstitial water: Presley, B. J. 07456
*Ontario*
Algoma District, Townships 31-30, Ranges 20-19: Ayres, L. D. 07240
*United States*
Midwestern, possibilities in black shales: Vine, James D. 07597
**Metamorphic rocks**
*Amphibolite*
Geochemistry, Wyoming, Bighorn Mts.: Uthe, R. E. 07527
*General*
Absolute age, Juneau Ice Field area, Alaska: Forbes, Robert B. 00201
Geochemistry, O isotopes, New Hampshire: Perry, Eugene C. 07443
Petrology, Precambrian basement, primitive crustal composition: Mehnert, K. R. 07063
Structural features, Pennsylvania, Wissahickon Fm.: Amenta, Roddy V. 00137
Textures, Virginia, Goode quadrangle: Khoury, S. G. 00164
*Iron-rich*
Geochemistry, Virginia, Arvonia Fm.: Smith, Kenneth G. 07496
*Metasediments*
Structural features, slaty cleavage, Colorado: Braddock, William A. 00203
Structural features, South Carolina, Walhalla area: Griffin, Villard S., Jr. 07305
*Mineral assemblages*
Calc silicate minerals, stability relations, experimental study: Kerrick, D. M. 07401
Nova Scotia, Annapolis-Saint Marys Bay area, contact and regional: Taylor, F. C. 07241
Puerto Rico, Robles Fm.: Jolly, Wayne T. 07393
*Mineral facies*
New Jersey, Newark Group, hornfels: VanHouten, Franklyn B. 07530
**Metamorphic rocks—Continued**
*Slate*
Textures, structural features, Michigan, Siamo Slate: Powell, C. McA. 07455
**Metamorphism**
*Contact*
British Columbia, Kwoiek area, overstepped reactions: Hollister, Lincoln S. 07134
Quebec, Manicouagan cryptoexplosion structure: Murtaugh, John G. 07691
*Progressive*
Oregon, Dothan-Rogue Fms., contact: Hotz, Preston E. 07614
*Regional*
Appalachians, northern, history: Zen, E-an. 07583
Maine, Waterville area, pyrrhotite-pyrite isograd: Williamson, Terrance C. 07545
Ontario, Algoma District, Townships 31-30, Ranges 20-19: Ayres, L. D. 07240
Types, relation to depth: Miyashiro, Akiho. 07050
**Metasomatism**
*Sandstone*
Nevada, Boyer Ranch Fm., minerals: Speed, Robert C. 07500
**Meteor craters**
*Arizona*
Meteor Crater, Fe-Ni spherules in soil: Hodge, Paul W. 00196
*General*
Age, Earth relative to Moon: Beals, C. S. 00090
*Kansas*
Winkler Crater *not* meteorite crater: Brookins, Douglas G. 00108
**Meteorites**
*Age*
Carbonaceous chondrites, Rb-87:Sr-87: Kaushal, Sushil K. 00088
*Canyon Diablo*
Impact crater area, Fe-Ni spherules in soil: Hodge, Paul W. 00196
*Composition*
Mineral assemblages, chemical history: Mueller, Robert F. 07745
Si concentration in metal of irons: Wai, Chien M. 07182
*Genesis*
Chondrites, mineral chemistry evidence: Mueller, Robert F. 07745
Low pressure, cliftonite-bearing: Brett, Robin. 07365
*Geochemistry*
Bromine, fractionation, analysis: Lieberman, Kenneth Warren. 07312
*Horse Creek*
Composition, Si in metal: Wai, Chien M. 07182
*Isotopes*
Analysis program, Univ. California: Kaplan, I. R. 07397
*Organic matter*
Analysis program, Univ. California: Kaplan, I. R. 07397
Studies, advances: Nagy, Bartholomew. 07693
*Phase equilibria*
Chondritic, oxygen activities: Walter, Louis S. 07535
*Tucson*
Composition, Si in metal: Wai, Chien M. 07182
**Mexico**
*Economic geology*
Kaolin, resources: Pasquera, R. 07675

**Mexico – Continued**
*Economic geology – Continued*
Lead-zinc, geochemistry, S-isotope fractionation: Rye, Robert O. 07476
*Engineering geology*
Soil mechanics and foundations, Mexico City area: Marsal, Raul J. 07753
*Geochemistry*
Cerro de Mercado, fluorapatite, analyses: Young, E. J. 07724
Rio Ameca, offshore region, clay minerals: Russell, Kenneth L. 07474
*Mineralogy*
Fluorapatite, Cerro de Mercado: Young, E. J. 07724
*Paleontology*
Mammalia, Quaternary, Tlapacoya area, bone beds: Alvarez, Ticul. 07234
*Stratigraphy*
Paleozoic, marine rocks, distribution, thickness: Lopez-Ramos, Ernesto. 07308
*Structural geology*
Baja California, continental margin: Normark, W. R. 07703
**Mica**
*New Mexico*
Pegmatites, potential for ground-mica products: Horst, William E. 07656
**Michigan**
*Petrology*
Northern, Siamo Slate, textures, structures: Powell, C. McA. 07455
*Stratigraphy*
Michigan basin, Bedford, Berea, Sunbury fms., correlation: deWitt, Wallace, Jr. 00132
*Structural geology*
Keweenaw Peninsula, Keweenawan tectonic conditions: Nordeng, Stephan C. 07702
**Micropaleontology**
*Cenozoic*
Calcareous nannofossils, worldwide zonation, n. spp.: Bukry, David. 07681
*Methods*
Precambrian material, applicability to extraterrestrial samples: Schopf, J. William. 07481
**Microscope methods**
*Fossil material, identification*
Invertebrate fragments, photomicrographs: Majewske, Otto P. 07180
*Instruments*
Electro-optical compensator, opaque minerals: Ypma, Peter J. M. 07557
**Microwave methods**
*Interpretation*
Depth limit of reflections, cave detection: Richer, Kenneth A. 00202
**Mineragraphy**
*Instruments*
Electro-optical compensator, opaque minerals: Ypma, Peter J. M. 07557
*Mineral identification*
Laurite, composition: Leonard, B. F. 07191
**Mineral data**
*Alleghanyite*
New Jersey, Franklin, Sterling Hill, X-ray, optical, spectrochemical studies: Cook, David. 07197
*Allophane*
High-alumina, differential thermal analysis: Snetsinger, Kenneth G. 07204
*Anatase*
Pressure-temperature studies: Jamieson, John C. 07749

**Mineral data – Continued**
*Apatite*
Crystal chemistry: McClellan, Guerry H. 07196
*Brookite*
Pressure-temperature studies: Jamieson, John C. 07749
*Calcite*
Surface energy measurements: Schmalz, Robert F. 00179
*Chalcopyrite*
Structure and crystal chemistry, interfacial reactions: McGlashan, D. W. 07165
*Cliftonite*
Low-pressure genesis in meteorites: Brett, Robin. 07365
*Clinopyroxene*
Montana, Little Belt Mts., properties, composition: Witkind, Irving J. 07309
*Cordierite*
Polymorphism, infrared and X-ray studies: Langer, K. 07201
*Daphnite*
Stability, phase relations: James, R. S. 07388
*Deerite*
California, Laytonville area, occurrence: Borner, Udo. 07115
*Diamond*
Dodecahedral faces, ruts and ridges, triangular depressions: Patel, A. R. 07190
*Faujasite*
High- and low-silica, series: Wright, Alan C. 07206
*Feldspar*
Composition, New York, Adirondack Mts., anorthosite: Crosby, Percy. 00148
Sanidine crystalline solutions, phase diagrams from equations of state: Waldbaum, D. R. 07187
Zoning, Maine, Lincoln sill syenite: Elders, Wilfred A. 07569
*Fluorapatite*
Properties, Mexico, Cerro de Mercado: Young, E. J. 07724
*Fluorite*
Occurrence, genesis, lacustrine rocks, Oregon: Sheppard, Richard A. 07608
Thermoluminescence, thermal modification: Semec, Branko. 07488
*Graphite*
Deformation, creep, stored energy: Green, W. V. 00091
*Howieite*
California, Laytonville area, occurrence: Borner, Udo. 07115
*Humite*
Structure, Mg-Fe ordering: Ribbe, P. H. 07465
*Hydrobasaluminite*
Genesis, description, Indiana: Sunderman, Jack A. 07195
*Kaolinite*
Transformation to metakaolin, interlayer spacings, variability: Mitra, G. B. 07199
*Kornelite*
New occurrence, California, Coso Hot Springs: Weber, Dwight. 00125
*Laueite*
Structure, not true polymorph of pseudolaueite: Baur, Werner H. 07189
*Laurite*
Composition, mineragraphy: Leonard, B. F. 07191

**Mineral data—continued**
*Leucophoenicite*
New Jersey, Franklin, Sterling Hill, X-ray, optical, spectrochemical studies: Cook, David. 07197
*Lithiophosphate*
North Carolina, Kings Mtn., description: White, John S., Jr. 07203
*Metamorphic minerals*
Geochemistry, Mg-Fe distribution, Ontario: Trzcienski, Walter E., Jr. 07525
*Mullite*
Relation to sillimanite, continuous isomorphous solid solution: Hariya, Y. 07200
*Plagioclase*
Composition, zoned: Subbarao, K. V. 07514
Optical properties, Adirondack Mts.: Onyeagocha, A. C. 07708
*Plumboferrite*
Structure, variations: Kohn, J. A. 07408
*Prehnite*
Color, occurrence, Lake Superior region, Isle Royale: Huber, N. King. 07723
Synthesis, stability relations: Liou, J. G. 07417
*Pseudolaueite*
Structure, not true polymorph of laueite: Baur, Werner H. 07189
*Rutile*
Pressure-temperature studies: Jamieson, John C. 07749
Stable equilibrium diagram: Dachille, Frank. 07205
*Silicate minerals*
Chemical bonding, X-ray emission spectroscopy: Dodd, Charles G. 07188
Hydrous sodium, magadiite deposit, California, Trinity County: Gude, Arthur J., 3d. 07357
*Sillimanite*
Relation to mullite, continuous isomorphous solid solution: Hariya, Y. 07200
*Sonolite*
New Jersey, Franklin, Sterling Hill, X-ray, optical, spectrochemical studies: Cook, David. 07197
*Sphalerite*
Geobarometry: Scott, S. D. 07485
*Staurolite*
Ordering differences, X-ray data: Dollase, W. A. 07567
*Talc*
Iron-bearing, unit-cell parameters, optical properties, oxygen fugacity: Forbes, Warren C. 07198
*Ultramafic minerals*
Flow mechanism, rate dependence: Raleigh, C. B. 07460
*Vivianite*
Earthy, thermal and X-ray studies, Kansas: Tien, Pei-lin. 07194
*Zircon*
Metamictization-thermoluminescence relations: Vaz, J. Eduardo. 07531
*Zussmanite*
California, Laytonville area, occurrence: Borner, Udo. 07115
**Mineral deposits, genesis**
*Arizona*
Uranium, Garnet Ridge: Gavasci, Anna Teresa. 07326
*Boron*
California, borax deposit, sulfide minerals, solubilities: Raab, Werner Joseph. 07337
**Mineral deposits, genesis—continued**
*Breccia pipes*
Processes: Richard, Kenyon. 07466
*Chromite*
Precambrian rocks, podiform deposits: Thayer, T. P. 07518
*Classification*
Sulfide deposits: Sawkins, Frederick J. 07479
*Experimental studies*
Iron, metasomatic deposits: Martin, R. F. 07430
Sphalerite-galena, sulfur isotope fractionation, Mexico: Rye, Robert O. 07476
*Igneous processes*
Manganese, Montana, Philipsburg batholith: Mohsen, Lotfi Abdel-Fattah M. 07333
*Lead-zinc*
Oklahoma-Kansas, Picher field: McKnight, Edwin T. 00207
*Massive sulfide*
Hydrothermal systems, chemical model: Helgeson, Harold C. 07360
*Polymetallic ores*
British Columbia, Hudson Bay Range: Kirkham, Rodney Victor. 07329
*Porphyry copper*
Mineralization model: James, Allan H. 07387
*Porphyry molybdenum*
British Columbia: Jonson, David C. 07394
*Strata-bound*
Zinc, manganese, New Jersey, Sterling Hill: Metsger, Robert W. 07682
*Structural controls*
Molybdenum, New Mexico, Questa: Rehrig, William Allen. 07339
**Mineral exploration**
*Geochemical methods*
Suspended solids technique: Perhac, Ralph M. 07441
*Statistical methods*
Sampling, coefficient of variation: Koch, George S., Jr. 07407
**Mineral zoning**
*Polymetallic ores*
British Columbia, Hudson Bay Range: Kirkham, Rodney Victor. 07329
*Porphyry molybdenum*
British Columbia: Jonson, David C. 07394
**Mineralogy**
*Crystal growth*
Gems, inclusions, genesis: Gubelin, E. 07287
*Education*
Teaching, introductory, Tinker Toy models: Buseck, Peter R. 00122
*Identification techniques*
Oligoclase separation from quartz by flotation: Herber, Lawrence J. 07311
*Methods*
Clay mixtures, separation, electrophoretic: Park, Robert G. 07748
*Nomenclature*
High and low silica faujasite series: Wright, Alan C. 07206
*Polymorphism*
Cordierite, infrared and X-ray studies: Langer, K. 07201
*Practice*
Mineralogists, founders of The American Mineralogist: Phair, George. 07192
*Publications*
American Mineralogist, history, 1916-1919: Phair, George. 07192

**Minnesota**
*Hydrogeology*
Southwestern, Yellow Medicine River watershed: Novitzki, R. P. 07233
*Maps, hydrogeologic*
Southwestern, Yellow Medicine River watershed: Novitzki, R. P. 07233
*Weathering*
Goodhue County, soil, biosequence, opal phytoliths: Verma, Shive D. 07647
**Mississippian**
*Alberta*
Wabamun Lake area, Banff and Exshaw Fms.: Martin, H. L. 07599
*Michigan*
Michigan basin, Kinderhookian, correlation, Appalachian basin: deWitt, Wallace, Jr. 00132
*Ohio*
Appalachian basin, Berea, Bedford, Sunbury fms., correlation: deWitt, Wallace, Jr. 00132
*Pennsylvania*
Appalachian basin, Berea, Bedford, Sunbury fms., correlation: deWitt, Wallace, Jr. 00132
Northeastern, unconformity: Sevon, William D. 00181
*United States*
Central, Crinoidea, acrocrinids, taxonomy, evolution: Moore, Raymond C. 07738
**Missouri**
*Maps, geologic*
Wyandotte (Okla.) quadrangle: McKnight, Edwin T. 00207
**Mohorovicic discontinuity**
*General*
Characteristics, evidence, review: McKenzie, D. P. 07758
*Seismic studies*
Atlantic Ocean, depth, variation: Ewing, John. 07104
**Mollusca**
*Quaternary*
Kansas, Dickinson County, Pleistocene, biostratigraphy: Gutentag, Edwin D. 07617
**Molybdenum**
*British Columbia*
Hudson Bay Mountain, genesis: Jonson, David C. 07394
**Montana**
*Geochemistry*
Boulder batholith, copper dispersion: Al-Hashimi, Abdul Razak K. 07324
Philipsburg batholith, Mn, abundance variations: Mohsen, Lotfi Abdel-Fattah M. 07333
*Geophysical surveys*
Boulder batholith, magnetic: Hanna, W. F. 07619
*Maps, geologic*
Northwestern: Mudge, Melville R. 00103
Varney quadrangle: Hadley, Jarvis B. 07215
*Maps, magnetic*
Libby quadrangle, airborne: U.S. Geological Survey. 07226
*Mineralogy*
Clinopyroxenes, Little Belt Mts., disparate rock types: Witkind, Irving J. 07309
Laurite, Stillwater Complex, mineragraphy, composition: Leonard, B. F. 07191
*Paleontology*
Pisces, Cretaceous, Hell Creek Fm., new amioid?, albulid: Estes, Richard. 07285
**Montana – Continued**
*Paleontology – Continued*
Vertebrata, Cretaceous, Hell Creek Fm., cf. Lance fauna: Estes, Richard. 07286
*Petrology*
Little Belt Mountains, acidic, intermediate, and basic rocks: Witkind, Irving J. 07309
Shonkin Sag laccolith, differentiation, mafic minerals: Nash, William P. 07695
*Stratigraphy*
Varney quadrangle, sections: Hadley, Jarvis B. 07215
*Structural geology*
Bighorn Mountains, Laramide trends: Hoppin, Richard A. 07374
Northwestern, disturbed belt, genesis, fault-fold complex: Mudge, Melville R. 00103
**Museums**
*United States National Museum*
Smithsonian-U.S. Geol. Survey fossil collection, methods: Yochelson, Ellis L. 07744
**Nevada**
*Absolute age*
Mesozoic granitic rocks, intrusive epochs: Evernden, J. F. 00208
*Areal geology*
Esmeralda County, Silver Peak region, Cenozoic history: Moiola, Richard James. 07334
Nye County, Pancake Range, Lunar Crater volcanic field: Scott, David Holcomb. 07341
*Engineering geology*
Slope stability, open-pit mines, failure prediction, microseismic technique: Wisecarver, David W. 07164
*Geomorphology*
Pyramid Lake area, terraces, evolution: Ritter, Dale F. 07468
*Hydrogeology*
Great Basin, eastern, ground-water movement, deuterium tracer: Winograd, Isaac J. 07548
Humboldt River valley, ground water-stream flow relations: Harsh, John Franklin. 07327
*Maps, geologic*
Western, Mesozoic granitic rocks, distribution: Evernden, J. F. 00208
*Paleontology*
Foraminifera, Pennsylvanian, Bird Spring Fm., fusulinid zones, correlation: Marshall, Frederick C. 07117
Graptolithina, Devonian, Lower, zoning: Berry, William B. N. 00217
Ostracoda, Cretaceous, Lower, Pine Valley quadrangle, nonmarine: Sohn, I. G. 07759
*Petrology*
Nye County, basalt, ultramafic xenoliths: Trask, Newell J. 07607
Western, Boyer Ranch Sandstone, metasomatism, minerals: Speed, Robert C. 07500
*Sedimentary petrology*
Lake Tahoe, Pleistocene sedimentation: Hyne, Norman J. 07384
*Stratigraphy*
Pennsylvanian, Bird Spring Fm., biostratigraphy: Marshall, Frederick C. 07117
Silurian-Devonian boundary, graptolite zones: Berry, William B. N. 00217
**New Brunswick**
*Structural geology*
North-central, Catamaran fault: Anderson, F. D. 00138
**New England**
*Absolute age*
White Mountain magma series, Jurassic-Cretaceous age, K-Ar: Foland, K. A. 00155

**New England—Continued**
*Geomorphology*
Continental rise, transport, bottom current data: Zimmerman, Herman B. 00191
Topography, evolution, similarity to tombstone weathering rates: Rahn, Perry H. 00175
**New Hampshire**
*Economic geology*
Lead-zinc-silver, eastern, occurrence: Cox, Dennis P. 00134
*Geochemistry*
Mascoma quadrangle, metamorphic sequence, oxygen isotopes: Perry, Eugene C. 07443
*Geomorphology*
Beaches, storms as modifying agents: Hayes, Miles O. 00162
*Geophysical surveys*
Southeastern, Exeter pluton, gravity: Bothner, Wallace A. 00142
*Structural geology*
Boundary Mountain anticlinorium, Second Lake anticline: Harwood, David S. 07611
**New Jersey**
*Economic geology*
Zinc, manganese, Sterling Hill: Metsger, Robert W. 07682
*Engineering geology*
Dams, Yards Creek reservoir, drilling methods, comparison: Smith, Bennett L. 07639
*Hydrogeology*
Coastal Plain, Englishtown Fm., computer model: Nichols, William D. 07701
*Mineralogy*
Sonolite, alleghanyite, leucophoenicite, Franklin and Sterling Hill: Cook, David. 07197
*Paleontology*
Cirripedia, Cretaceous, Upper, Middletown, acrothoracican: Tomlinson, Jack T. 07280
*Petrology*
Newark Basin, basalt, paleoflow structures: Manspeizer, Warren. 07428
Newark Group, hornfels facies: VanHouten, Franklyn B. 07530
*Sedimentary petrology*
Delaware River Estuary, sediments: Weil, Charles B. 00187
*Stratigraphy*
Cretaceous-Tertiary datum, biostratigraphy: Olsson, Richard K. 00172
*Structural geology*
Port Jervis thrust fault: Soren, Julian. 00183
**New Mexico**
*Absolute age*
Tertiary intrusive-volcanic-mineralization episodes: Kottlowski, Frank E. 07573
*Economic geology*
Mica, from pegmatites, potential for ground-mica products: Horst, William E. 07656
*Engineering geology*
Gas storage, pressure-monitoring system, Bandelier Tuff: Kunkler, J. L. 07726
*Hydrogeology*
Capitan Limestone, aquifer, computer simulation: Peterson, J. B. 07635
Roswell artesian basin, aquifers, ground-water movement: Maddox, George Edward. 07332
Southeastern, Capitan Limestone, study methods: Hiss, W. L. 07141
*Structural geology*
Questa molybdenum deposit, fractures, mineralization: Rehrig, William Allen. 07339
**New York**
*Absolute age*
Hudson Highlands, Rosetown complex, K-Ar: Ratcliffe, Nicholas M. 00176
*Engineering geology*
Applications, Niagara Falls preservation: Wilkinson, Thomas A. 07543
*General*
Bibliography, ground-water resources, through 1967: MacNish, Robert D. 07242
*Geochemistry*
Adirondack Mountains, anorthosite, feldspars, composition: Crosby, Percy. 00148
*Geomorphology*
Fire Island Inlet, migration, sedimentation: Kumar, Naresh. 00166
Niagara Falls, erosion rate, horizontal configuration: Philbrick, Shailer S. 07447
*Geophysical surveys*
Gravity: Revetta, Frank A. 07464
*Hydrogeology*
Bibliography, ground-water resources, through 1967: MacNish, Robert D. 07242
Long Island, Bay Park, deep-well recharge, treated sewage water: Vecchioli, John. 07532
*Paleontology*
Algae, Pleistocene, charophytes, cf. living: Daily, Fay Kenoyer. 07145
*Petrology*
Peekskill pluton, textures: Anibal, Espejo C. 00139
*Structural geology*
Becraft, Alsen Limestones, folding, mechanism: Spang, John H. 07499
Hudson Highlands, Rosetown complex, Ramapo fault system: Ratcliffe, Nicholas M. 00176
Port Jervis thrust fault: Soren, Julian. 00183
Staten Island serpentinite, tectonic history: Miller, William H. 00169
**Newfoundland**
*Stratigraphy*
New World Island area: Horne, Gregory Stuart. 07328
Ordovician-Silurian, sedimentary-volcanic sequence, Magog belt: Horne, Gregory S. 07375
*Structural geology*
Belle Bay, Precambrian-Paleozoic contact, fault: Williams, Harold. 00188
Burlington Peninsula, Fleur de Lys Supergroup, recumbent folds: Coates, H. J. 00147
New World Island area, tectonics: Horne, Gregory Stuart. 07328
Western, Taconic orogeny, Long Point Fm.: Kay, Marshall. 07399
**Nickel**
*Ontario*
Sudbury, occurrence: Naldrett, A. J. 07694
**North America**
*Absolute age*
Shield areas, terrestrial leads, least radiogenic: Tilton, G. R. 07523
*Areal geology*
Continental rise, eastern, history: Emery, K. O. 00099
*Earthquakes*
Seismicity, relation to tectonic activity: Woollard, George P. 07097
*Geophysical surveys*
Crustal studies, seismic, review: Healy, John H. 07103

**North America—Continued**
*Geophysical surveys—Continued*
Heat flow, regional, pattern: Simmons, Gene. 07092
*Paleontology*
Mammalia, Pliocene-Holocene, extinction-origination equilibria: Webb, S. David. 07167
*Sedimentary petrology*
Midcontinent, Devonian, sand distribution patterns, craton behavior: Summerson, C. H. 00218
*Seismic surveys*
Mantle studies, P-wave velocity, regional variation: Herrin, Eugene. 07106
*Stratigraphy*
Ordovician, Whiterock stage, Northern Hemisphere correlations: Ross, Reuben James, Jr. 00210
*Structural geology*
Crustal structure, seismic data, review: Healy, John H. 07103
Midcontinent, Devonian tectonics from sand distribution: Summerson, C. H. 00218
Tectonics, collected papers: King, Philip B. 07130
Tectonics, relation to seismicity pattern: Woollard, George P. 07097
**North Carolina**
*General*
State University, summer institutes in earth science for teachers: Anderson, Norman D. 07229
*Mineralogy*
Lithiophosphate, Kings Mtn., pegmatite: White, John S., Jr. 07203
*Sedimentary petrology*
Coastal Plain, soils, fragipan horizons, identification: Steele, Forrest. 07727
**North Dakota**
*Geochemistry*
Prairie potholes, soils, variations, ground water: Miller, Reuben F. 07725
*Stratigraphy*
Paleocene-Eocene, Golden Valley Fm., western: Hickey, Leo J. 07138
**Northwest Territories**
*Economic geology*
Mineral resources, Mackenzie, Nahanni district, summary 1968: Findlay, D. C. 07128
*Geomorphology*
Arctic Archipelago, frost action, hummocks on terrace slopes: Habrich, Wulf. 07259
Devon Island, landform evolution, periglaciation effects: King, Roger Hatton. 07323
*Geophysical surveys*
Mackenzie delta, Reindeer well, temperature logging: Jessop, A. M. 00093
*Maps, geologic*
Ellesmere Island, M'Clintock Inlet area: Trettin, H. P. 07119
Ellesmere Island, Yelverton Pass region: Nassichuk, W. W. 07598
*Maps, magnetic*
Mackenzie, Aylmer Lake area, airborne: Canada Geological Survey. 07295
Mackenzie, Carp Lakes area, airborne: Canada Geological Survey. 07292
Mackenzie, Contwoyto Lake area, airborne: Canada Geological Survey. 07301
Mackenzie, Hardisty Lake area, airborne: Canada Geological Survey. 07299
Mackenzie, Hearne Lake area, airborne: Canada Geological Survey. 07288
**Northwest Territories—Continued**
*Maps, magnetic—Continued*
Mackenzie, Indin Lake area, airborne: Canada Geological Survey. 07298
Mackenzie, Lac de Gras area, airborne: Canada Geological Survey. 07296
Mackenzie, MacKay Lake area, airborne: Canada Geological Survey. 07291
Mackenzie, Marian River area, airborne: Canada Geological Survey. 07294
Mackenzie, Nose Lake area, airborne: Canada Geological Survey. 07300
Mackenzie, Walmsley Lake area, airborne: Canada Geological Survey. 07290
Mackenzie, Wecho River area, airborne: Canada Geological Survey. 07293
Mackenzie, Winter Lake area, airborne: Canada Geological Survey. 07297
Mackenzie, Yellowknife area, airborne: Canada Geological Survey. 07289
*Stratigraphy*
Ordovician-Pennsylvanian, Ellesmere Island, M'Clintock Inlet area: Trettin, H. P. 07119
Pennsylvanian-Cretaceous, Ellesmere Island, Yelverton Pass region: Nassichuk, W. W. 07598
*Structural geology*
Ellesmere Island, M'Clintock Inlet area, general: Trettin, H. P. 07119
**Nova Scotia**
*Areal geology*
Annapolis-Saint Marys Bay area: Taylor, F. C. 07241
*Economic geology*
Petroleum, exploration, Sable Island test well: Pamenter, Bev. 00092
*Maps, geologic*
Annapolis-Saint Marys Bay area: Taylor, F. C. 07241
*Stratigraphy*
Cretaceous-Quaternary, Sable Island, test well: Pamenter, Bev. 00092
**Nuclear explosions**
*Applications*
Natural gas reservoir stimulation: Johansen, Robert T. 07125
*BENHAM*
Nevada Test Site, transient and residual strains: Smith, Stewart W. 07358
*Deformation*
Transient and residual strains, BENHAM event: Smith, Stewart W. 07358
*Seismic effects*
Energy release, dissipation: Tocher, Don. 00128
Energy release, relations: Hadley, James W. 00127
*Underground*
Safety program, summary: U.S. Atomic Energy Commission. 07752
**Ohio**
*Economic geology*
Construction materials, architectural aggregate, properties, testing: Stith, David A. 07232
Petroleum, Cincinnati Arch area, possibilities: Patton, John B. 07112
*General*
Bibliography, 1961-65: Smyth, Pauline. 07225
Education, earth science, teacher-training program: Roth, Robert A. 07228
*Glacial geology*
Southeastern, pre-Illinoian advance: Ray, Louis L. 07623

**Ohio—Continued**
*Paleontology*
Conodonts, Pennsylvanian, Pottsville rocks, eastern, biostratigraphy: Merrill, Glen K. 07440
Silurian, bioherms, southwestern, paleoecology: Kissling, Don L. 07406
*Petrology*
Logs, cores, subsurface, catalog 1963-67: Safford, Frederick B. 07120
*Stratigraphy*
Appalachian basin, Bedford, Berea, Sunbury fms., Kinderhook age: deWitt, Wallace, Jr. 00132
**Oil sands**
*Utah*
Occurrence, potential: Ritzma, Howard R. 07124
**Oil shale**
*Colorado*
Green River Fm., carboxylic acids, experimental study: Burlingame, A. L. 07209
**Oklahoma**
*Economic geology*
Lead-zinc, Picher field: McKnight, Edwin T. 00207
Natural gas, helium, Panhandle, occurrence: Moore, Carl A. 07214
Petroleum, Anadarko basin, western, Marmaton Group: Cambridge, Thomas R. 07213
*Hydrogeology*
Ozark region, springs: Bingham, Roy H. 07275
*Maps, geologic*
Wyandotte quadrangle: McKnight, Edwin T. 00207
*Paleontology*
Fauna, Pennsylvanian, Wewoka Fm., marine communities, Hughes County: West, Ronald Robert. 07224
*Sedimentary petrology*
Anadarko basin, western, Marmaton Group, oil reservoirs: Cambridge, Thomas R. 07213
Ouachita Mountains, Johns Valley Fm., boulders, sedimentation: Shideler, Gerald L. 07489
*Stratigraphy*
Wyandotte quadrangle: McKnight, Edwin T. 00207
**Ontario**
*Absolute age*
Ottawa area, bog sections, pollen zone: Mott, R. J. 07601
*Areal geology*
Algoma District, Townships 31-30, Ranges 20-19: Ayres, L. D. 07240
Lake Panache-Collins Inlet map-area: Frarey, M. J. 07131
*General*
Research, field work summary, 1969: Pye, E. G. 07222
*Geochemistry*
Whetstone area, metamorphic minerals, Fe-Mg distributions: Trzcienski, Walter E., Jr. 07525
*Geomorphology*
Lake of the Woods area, meteor crater, ancient: Beals, C. S. 00090
*Glacial geology*
Waterloo area, till fabrics, ice-flow direction: Harris, Stuart A. 07677
*Hydrogeology*
Cochrane area, glacial complex, ground water: Parsons, Myles Lyle. 07335
**Ontario—Continued**
*Maps, geologic*
Algoma District, Townships 31-30, Ranges 20-19: Ayres, L. D. 07240
Lake Panache-Collins Inlet area: Frarey, M. J. 07131
*Paleontology*
Palynology, Quaternary, Ottawa area, bog sections, zones, dates: Mott, R. J. 07601
*Petrology*
Sudbury, nickel irruptive: Naldrett, A. J. 07694
*Sedimentary petrology*
Glacial till sheets, pebble orientation: Harris, Stuart A. 07677
*Stratigraphy*
Silurian, Salina Group, correlation with Appalachian basin: Rickard, Lawrence V. 07108
**Ordovician**
*Alabama*
Upper, stratigraphy: Neathery, Thornton L. 07696
*Appalachians*
Southern, sedimentation, color origins: Thompson, Allan M. 07522
*Newfoundland*
Magog belt, stratigraphy: Horne, Gregory S. 07375
*Northern Hemisphere*
Middle, Whiterock stage, faunal correlations: Ross, Reuben James, Jr. 00210
*Pennsylvania*
Central, carbonate rocks, stratigraphy, petrography: Rones, Morris. 07754
Central, Loysburg Fm., Milroy Member: Chafetz, Henry S. 07739
*United States*
Eastern, Middle, correlation: Raring, A. W. 07461
*Virginia*
Russell County, Blackford Fm., Chazyan volcanism zone: Heyman, Louis. 00206
**Oregon**
*Absolute age*
Newberry Caldera, Central Pumice Cone, wood, C-14: Higgins, Michael W. 07605
*Economic geology*
Fluorspar, Malheur County, occurrence: Sheppard, Richard A. 07608
*Mineralogy*
Fluorite, Malheur County, lacustrine rocks, authigenic: Sheppard, Richard A. 07608
*Paleontology*
Pisces, Oligocene, John Day Fm., new umbrid, esocoid relations: Cavender, Ted. 07276
*Petrology*
Needle Point pluton, melting relations, experimental study: Piwinskii, A. J. 00095
Newberry Caldera, pumice deposits: Higgins, Michael W. 07605
Southwestern, Dothan-Rogue Fms., contact, progressive metamorphism: Hotz, Preston E. 07614
*Sedimentary petrology*
Continental slope, Holocene sedimentation: Spigai, J. J. 07501
*Stratigraphy*
Jurassic, Dothan-Rogue Fms., contact relations: Hotz, Preston E. 07614
*Structural geology*
Southwestern, Dothan-Rogue Fms., fault contact: Hotz, Preston E. 07614

**Organic materials**
*Amino acids*
Green River Fm.: Kvenvolden, Keith A. 07413
*Analytical data*
Green River oil shale, carboxylic acids: Burlingame, A. L. 07209
*Analytical methods*
Green River oil shale, carboxylic acids, extractions, oxidations: Burlingame, A. L. 07209
*Carbohydrates*
Devonian-Permian plant fossils, analysis: Swain, Frederick M. 07750
*Carbonaceous complexes*
Illinois-Kentucky fluorspar district, gangue: Mueller, George. 07690
*Geochemistry*
Aqueous environments, complexification: Hoffman, James I. 07133
International meeting, 1968, proceedings: Schenck, P. A. 07207
Life, origin: VanHoeven, William, Jr. 07313
*Hydrocarbons*
Diffusion in water, effects of salt concentration, experiments: Bonoli, Luciano. 07211
*Porphyrins*
Lava, Hawaii, Kilauea, Alae Crater: Hodgson, Gordon W. 07762
*Proteins*
Carbonate genesis, role: Mitterer, Richard M. 07685
**Orogeny**
*Acadian*
Appalachians, northwestern, ultramafic intrusion: Stevens, R. K. 07507
*Laramide*
Montana, genesis of disturbed belt: Mudge, Melville R. 00103
*Periodicity*
Cordilleran continental margin, evolution: Roberts, Ralph J. 07580
*Taconic*
Appalachians, northwestern, ultramafic intrusion: Stevens, R. K. 07507
Newfoundland, western, Long Point Fm.: Kay, Marshall. 07399
**Ostracoda**
*Cyprideinae*
Cretaceous, Nevada, Pine Valley quadrangle, taxonomy: Sohn, I. G. 07759
*Cythereis eaglefordensis*
Cretaceous, United States, index fossil: Hazel, Joseph E. 07618
*Quaternary*
Kansas, Dickinson County, Pleistocene, biostratigraphy: Gutentag, Edwin D. 07617
**Oxygen**
*Isotopes*
O-18, ultramafic rocks, serpentinization: Wenner, David B. 07539
**Pacific Ocean**
*Geochemistry*
Pelagic clay, analyses, metals, P: Cronan, D. S. 07186
Solubility, molal volume, calcium carbonate: Hawley, J. 07185
*Geophysical surveys*
Baja California area, magnetic: Chase, C. G. 00209
California-Oregon offshore areas, gravity, anomalies: Dehlinger, Peter. 07080
Eastern, lineated topography: Johnson, David A. 07390
**Pacific Ocean—Continued**
*Geophysical surveys*—Continued
Hawaiian Ridge, gravity, interpretation: Malahoff, Alexander. 07081
Magnetic, linear anomaly sets, tectonic interpretation: Vacquier, Victor. 07084
Mantle studies, anisotropy, seismic, off California: Raitt, Russell W. 07756
*Paleoclimatology*
Quaternary, late, northeastern, biostratigraphy: Fowler, Gerald A. 07571
*Paleomagnetism*
Axial dipole field, assumptions, paradoxes: Vine, F. J. 07533
*Paleontology*
Foraminifera, Cenozoic, northeastern, biostratigraphy: Olsson, Richard K. 07707
*Sedimentary petrology*
Bering shelf, relict glacial sediments: Silberman, M. L. 07491
Bering shelf, relict sediments, provenance, dispersal: Rathnam, Venkata K. 07462
Bering shelf, sediment patterns, relict, modern: Nelson, C. Hans. 07697
Northeastern, JOIDES drilling project, sediments: McManus, Dean A. 07437
*Structural geology*
Gorda Escarpment, tectonics: Silver, Eli A. 07492
West of Baja California, sea-floor spreading: Chase, C. G. 00209
**Paleobotany**
*Geochemistry*
Devonian-Permian species, carbohydrate components, analysis: Swain, Frederick M. 07750
*Pennsylvanian*
Indiana, coal ball flora, classification: Judd, Robert W. 07151
**Paleoclimatology**
*Applications*
Continental drift, conflicting evidence, review: Meyerhoff, A. A. 00094
*Caribbean region*
Foraminiferal datums, Plio-Pleistocene boundary: Lamb, James L. 07574
*Cenozoic*
Epoch boundaries, paleotemperature cycles: Bandy, Orville L. 07641
*Indicators*
Foraminifera, Pleistocene, Atlantic Ocean, cores: Imbrie, John. 07385
Shelf-edge carbonates, sea levels, anomalies, Quaternary: Sanders, John E. 00178
*Quaternary*
Atlantic Ocean, Pleistocene changes, coccolith floras: McIntyre, Andrew. 07435
California, Searles Lake, salt crystallization temperatures: Smith, George I. 07495
Greenland, icecap, microparticle distribution: Hamilton, Wayne L. 07655
Gulf of Mexico, Pleistocene, cycles: Beard, John H. 07561
Ontario, Ottawa area, bog sections, pollen zones: Mott, R. J. 07601
Pacific Ocean, northeastern, biostratigraphy: Fowler, Gerald A. 07571
*Wind directions*
Cambrian, United States, north-central, northeastern: Seeland, David A. 07487

**Paleoecology**
*Algae*
Pennsylvanian, marine, U.S. midcontinent, Leavenworth Ls.: Toomey, Donald Francis. 07239
*Analysis*
Shelf benthos, Phanerozoic: Valentine, James W. 07528
Silurian and Holocene bivalve communities: Levinton, Jeffrey S. 07416
*Foraminifera*
Holocene, indicators, California, Santa Barbara Basin, plankton: Berger, Wolfgang H. 00085
Marine, sessile forms, diastem indicators: Kilbourne, Richard T. 07403
*Indicators*
Foraminifera, wall structures, biofacies: Buchanan, Hugh. 00144
*Mammalia*
Pleistocene, terrestrial, muskrat: Nelson, Robert S. 07698
*Ordovician*
Marine, Appalachians, color origins: Thompson, Allan M. 07522
*Quaternary*
Lacustrine-terrestrial, Kansas, Dickinson County: Gutentag, Edwin D. 07617
*Silurian*
Reef, Ohio, southwestern: Kissling, Don L. 07406
*Tertiary*
Lacustrine, Utah, Green River Fm., lower: Baer, James L. 07118
Marine, California, Pliocene: Stanton, Robert J., Jr. 07504
Marine, California, San Juan basin, Neogene: Adegoke, Oluwafayisola S. 07284
Marine, Maryland, Virginia, Potomac River valley, Paleocene: Kauffman, Erle G. 07398
*Vertebrata*
Cenozoic, terrestrial-marine, Atlantic Coastal Plain: Whitmore, Frank C., Jr. 07542
**Paleogeography**
*Paleozoic*
Mexico: Lopez-Ramos, Ernesto. 07308
*Quaternary*
Virginia, James River drainage basin, Pleistocene: Spencer, R. S. 00087
*Tertiary*
Arizona, northern, Bidahochi Fm., Pliocene: Wright, James C. 07616
**Paleomagnetism**
*Applications*
Continental drift, conflicting evidence, review: Meyerhoff, A. A. 00094
*Methods*
Marine sediments, correlation: Opdyke, Neil D. 07709
Spherical harmonic analysis: Wells, John Maurice. 07353
*Variations*
Determination, interpretation, acquisition, application: Runcorn, S. K. 07757
**Paleontology**
*Automatic data processing*
Information structure: Sanders, Robert B. 07478
*Biotic provinces*
Paleozoic, late, evolution: Ross, Charles A. 07473
*Life, origin*
Chemical evolution, primitive Earth, experimental studies: Lemmon, Richard M. 00079
**Paleontology—Continued**
*Life, origin*—Continued
Geochemical considerations: VanHoeven, William, Jr. 07313
Planetary organic analyses, prebiotic chemistry: Orgel, Leslie E. 07710
*Methods*
Collecting and storing in museums, evaluation: Yochelson, Ellis L. 07744
Rock and thin section techniques, invertebrates: Majewske, Otto P. 07180
Vertebrata, collections, Cenozoic vs. pre-Cenozoic: Hotton, Nicholas, 3d. 07676
**Paleozoic**
*Alaska*
Saint Lawrence Island, stratigraphy: Patton, William W., Jr. 07615
*Biotic provinces*
Late, evolution: Ross, Charles A. 07473
*Massachusetts*
Western, early, correlation: Hatch, Norman L. 00161
*Mexico*
Thickness and distribution: Lopez-Ramos, Ernesto. 07308
*Northwest Territories*
Ellesmere Island, M'Clintock Inlet area, stratigraphy: Trettin, H. P. 07119
Ellesmere Island, Yelverton Pass region, upper: Nassichuk, W. W. 07598
*Nova Scotia*
Annapolis-Saint Marys Bay map area: Taylor, F. C. 07241
*Utah*
Star Range, stratigraphy: Baetcke, Gustav Berndt. 07325
**Palynology**
*Environmental analysis*
Saskatchewan, past vegetation zones, from modern spectra: Mott, R. J. 07600
*Pennsylvanian*
Texas, Young County, Eddleman Coal: Stone, J. Fred. 07661
*Quaternary*
Ontario, Ottawa area, bog section, pollen zones, dates: Mott, R. J. 07601
Saskatchewan, vegetation zones, Holocene spectra: Mott, R. J. 07600
**Palynomorphs**
*Aquilapollenites*, spp.
Cretaceous, Alaska, Upper, descriptions, eight new: Tschudy, Bernadine D. 07158
*Duplicatotriletes heueri*, n.gen., n.sp.
Pennsylvanian, Texas, Young County, Eddleman Coal: Stone, J. Fred. 07661
*Fibulapollis scabratus*, n.sp.
Cretaceous, Alaska, Colville Group, Colville River area: Tschudy, Bernadine D. 07158
*Tripojectacites*
Cretaceous, distribution, N. Am., Soviet Union: Stanley, E. A. 00184
**Panama**
*Geophysical surveys*
Darien Province, radar: MacDonald Harold C. 07426
**Patterned ground**
*Hummocks*
Northwest Territories, Arctic Archipelago, terrace slopes: Habrich, Wulf. 07259
**Peat**
*Florida*
Everglades, absolute age, development rate: McDowell, L. L. 07644

**Peat—Continued**
*Pennsylvania*
Northeastern, occurrence, possibilities: Edgerton, Curtis D. 07652
*Properties*
Field studies, response to plate loading: LoPinto, Victor J. 00086
**Pelecypoda**
*Buchia*
Jurassic-Cretaceous, California, Colyear Springs-Paskenta area: Jones, D. L. 07760
*Eomiltha scolaroi*, n. sp.
Miocene, Florida, Chipola Fm., lucinid: Vokes, Harold E. 07680
*Mercenaria mercenaria*
Calcification, 24-hour deposition, experimental: MacClintock, Copeland. 07425
*Miltha carmenae*, n. sp.
Pleistocene, Florida, Lake Okeechobee area: Vokes, Harold E. 07679
*Miltha*, s.s.
Cenozoic, taxonomy, Florida Neogene species: Vokes, Harold E. 07679
*Taxonomy*
Lucinidae, Cenozoic: Vokes, Harold E. 07679
**Pennsylvania**
*Economic geology*
Ceramic materials, Mercer fireclay, western, genesis: Bragonier, William A. 00143
Clays, Monroe County, occurrence: Epstein, Jack B. 07610
Construction materials, ceramic materials, Greene County, analyses: Roen, John B. 07735
Peat, northeastern, occurrence, possibilities: Edgerton, Curtis D. 07652
Petroleum, natural gas, developments, 1968: Kelley, Dana R. 07650
Phosphate, Juniata County, W. L. Newman mine, occurrence: Carter, William D. 07651
*Engineering geology*
Landslides, highway construction: Flint, Norman K. 00154
*Geochemistry*
Central, carbonate rocks, silica, correlation: Rones, Morris. 07754
Nittany Valley, ground water, carbonate saturation: Langmuir, Donald. 07414
*Geomorphology*
Central, caves, orientation: Deike, Ruth G. 07304
Slippery Rock, Muddy Creeks, pre-Pleistocene drainage: Szucs, F. K. 00186
*Geophysical surveys*
Eastern, gravity: Revetta, Frank A. 07464
Western, well logging, gamma-ray: Wagner, Walter R. 07649
*Sedimentary petrology*
Central, carbonate rocks, thin-section study: Rones, Morris. 07754
Central, Ordovician carbonates, Lower-Middle contact: Chafetz, Henry S. 07739
Delaware River Estuary, sediments: Weil, Charles B. 00187
Northeastern, Catskill Fm., lithofacies, economic significance: Glaeser, J. Douglas. 00157
Northwestern, Pleistocene tills, areal variation: White, George W. 07659
Western, Allegheny, Conemaugh rocks, sedimentation: Swinehart, James B. 00185
**Pennsylvania—Continued**
*Stratigraphy*
Appalachian basin, Bedford, Berea, Sunbury fms., Kinderhook age: deWitt, Wallace, Jr. 00132
Mississippian, northeastern, unconformity: Sevon, William D. 00181
Ordovician, Loysburg Fm., Milroy Member: Chafetz, Henry S. 07739
Ordovician, Middle, lower, carbonate rocks, central: Rones, Morris. 07754
Pleistocene, lower till units, northwestern: White, George W. 07659
*Structural geology*
Allegheny plateau, folds, wavelengths, model: Sherwin, Jo-Ann. 00182
Anthracite area, Catskill-Pocono contact, faulting: Hoskins, Donald M. 00163
Philadelphia area, Wissahickon Fm., deformation, metamorphism: Amenta, Roddy V. 00137
Port Jervis thrust fault: Soren, Julian. 00183
Triassic basin, tectonics: Faill, Rodger T. 07570
**Pennsylvanian**
*Crustacea*
Evolution: Schram, Frederick R. 07483
*Indiana*
Paleobotany, coal ball flora, classification: Judd, Robert W. 07151
*Kentucky*
Ashland area, Allegheny rocks, sedimentation: Whaley, Peter Walter. 07345
Western, basal, channel complex: Shawe, Fred R. 07625
*Nevada*
Mountain Springs Pass area, Foraminifera, Bird Spring Fm.: Marshall, Frederick C. 07117
*Ohio*
Eastern, conodonts, biostratigraphy: Merrill, Glen K. 07440
*Oklahoma*
Anadarko basin, western, Marmaton Group: Cambridge, Thomas R. 07213
Hughes County, Wewoka Fm., fauna, marine communities: West, Ronald Robert. 07224
*Pennsylvania*
Western, Allegheny, Conemaugh rocks, sedimentation: Swinehart, James B. 00185
*Texas*
Anadarko basin, western, Marmaton Group: Cambridge, Thomas R. 07213
Young County, palynomorphs, Eddleman Coal: Stone, J. Fred. 07661
*United States*
Central, Crinoidea, acrocrinids, taxonomy, evolution: Moore, Raymond C. 07738
Midcontinent, algae, Leavenworth Ls.: Toomey, Donald Francis. 07239
*Virginia*
Southwestern, stratigraphy: Miller, Ralph L. 07684
**Permian**
*Alaska*
Central, Rampart Group: Brosgé, W. P. 07721
Delta River area, Foraminifera, biostratigraphy: Petocz, Ronald George. 07336
McCarthy quadrangle, Skolai Group: Smith, James G. 00214
**Petrofabrics**
*Anhydrite*
Winnipegosis Formation, Saskatchewan: Shearman, D. J. 07363

**Petroleum**
*Atlantic Ocean*
Sohm Abyssal Plain, possibilities, seismic exploration: Watson, Jerry A. 00083
*California*
Los Angeles and Ventura basins, genesis: Philippi, George Theodor. 07208
*Continental margin*
Occurrence, exploration: Hedberg, Hollis D. 00199
*Exploration*
Automatic data processing, applications, symposium: Merriam, Daniel F. 07587
Automatic data processing, Markov forecasting techniques: Lea, Graham. 07589
Automatic data processing, subsurface data: Lewis, James O. 07594
Geochemical logging, new tool: Feugere, G. 00195
Statistical methods, hydrocarbon distribution: Davis, John C. 07593
*Gulf of Mexico*
Deep offshore possibilities: Walker, Jack R. 07273
West Florida Platform, possibilities: Winston, George O. 07272
*Indiana*
Cincinnati Arch area, possibilities: Patton, John B. 07112
*Kentucky*
Cincinnati Arch area, possibilities: Patton, John B. 07112
Sutherland quadrangle, occurrence: Johnson, William D., Jr. 07220
*Nova Scotia*
Exploration, Sable Island test well: Pamenter, Bev. 00092
*Ohio*
Cincinnati Arch area, possibilities: Patton, John B. 07112
*Oklahoma*
Anadarko basin, western, Marmaton Group, exploration: Cambridge, Thomas R. 07213
*Pennsylvania*
Developments, 1968: Kelley, Dana R. 07650
*Texas*
Anadarko basin, western, Marmaton Group, exploration: Cambridge, Thomas R. 07213
**Phanerozoic**
*United States*
Conterminous, sediment volumes: Gilluly, James. 00102
**Phase equilibria**
*Alumina-water*
New phase: Gigl, Paul D. 00192
*Anatase-brookite-rutile*
Reaction boundaries, not phase boundaries: Jamieson, John C. 07749
Rutile only stable phase: Dachille, Frank. 07205
*Anorthite-diopside-hedenbergite*
High pressures, temperatures: Akella, Jagannadham. 07559
*Basalt-H-C-O*
Ni-NiO buffer, compositions: Holloway, John R. 07135
*Carbonate systems + aragonite*
Subsolidus phase relations: Chang, Luke L. Y. 07564
*Chondritic meteorites*
Mineral assemblages, liquidus relations: Mueller, Robert F. 07745
**Phase equilibria — Continued**
*Daphnite*
Stability limits: James, R. S. 07388
*Experimental studies*
Mantle, petrology of upper, recent studies: O'Hara, M. J. 07057
Melting, granite, quartz monzonite, granodiorite: Piwinskii, A. J. 00095
Rhyolite glass, devitrification rates: Lofgren, Gary. 00110
*Fosterite-diopside-akermanite-leucite*
Volcanic rocks, ultramafic, genesis: Gupta, Alok K. 00159
*Iron sulfides*
Low-temperature: Taylor, Lawrence A. 07517
*Mullite-sillimanite*
Solid solution, continuous isomorphous: Hariya, Y. 07200
*Na-Al-K-Si-O*
Diagrams from equations of state: Waldbaum, D. R. 07187
*Olivine-pyroxene*
Oxygen fugacity: Williams, Richard J. 07544
*Prehnite*
Synthesis, stability relations: Liou, J. G. 07417
*Sanidine crystalline solutions*
Diagrams from equations of state: Waldbaum, D. R. 07187
*Sulfide systems*
Relations: Kullerud, Gunnar. 07410
*Topaz-vapor*
Excess silica, water: Rosenberg, P. E. 07472
*Wollastonite-hedenbergite*
Fe and Ca relations: Rutstein, Martin S. 07475
**Phosphate**
*Pennsylvania*
Juniata County, W. L. Newman mine, occurrence: Carter, William D. 07651
**Photogeology**
*Photography*
Low sun-angle vertical, cf. infrared scanning: Howard, Arthur D. 00106
Space, coastal oceanography: Nichols, Maynard M. 07699
*United States*
Southeastern, continental shelf, sediment dispersal, space photos: Stevenson, Robert E. 07508
**Pisces**
*Coriops amnicolus*, n.gen., n.sp.
Cretaceous, Wyoming, Montana, Lance, Hell Creek Fms., albulid: Estes, Richard. 07285
*Cretaceous*
Montana, Hell Creek Fm., cf. Lance fauna: Estes, Richard. 07286
*Esocoidei*
Cenozoic, osteology, taxonomic relations: Cavender, Ted. 07276
*Novumbra oregonensis*, n.sp.
Oligocene, Oregon, John Day Fm., esocoid relations: Cavender, Ted. 07276
*Palaeolabrus montanensis*, n.sp.
Cretaceous, Montana, Hell Creek Fm., amioid?: Estes, Richard. 07285
**Placers**
*Rutile-ilmenite*
Virginia, Roseland district: Herz, Norman. 00215
**Polymetallic ores**
*Utah*
Star Range, occurrence: Baetcke, Gustav Berndt. 07325

**Popular and elementary geology**
*Atlantic Ocean*
Genesis: Hansen, L. Taylor. 07168
*Earth*
Origin: Haber, Heinz. 07176
*Quaternary*
Pleistocene ecosystem: Gordon, Wesley D. 07179
*United States*
Western: Sutton, Ann. 07169
**Precambrian**
*Arizona*
Gila County, absolute age: Livingston, Donald E. 07418
*Colorado*
Needle Mountains, history of events: Barker, Fred. 07718
Poncha Springs NE quadrangle, gneisses, quartz monzonite, intrusive rocks: VanAlstine, R. E. 07719
*Crust*
Composition from basement complex petrology: Mehnert, K. R. 07063
*Ontario*
Algoma District, Townships 31-30, Ranges 20-19: Ayres, L. D. 07240
*Virginia*
Harpers Fm., sedimentation: Schwab, Frederic L. 00180
**Protista**
*Calcareous nannofossils*
Cenozoic, worldwide zonation, n. spp.: Bukry, David. 07681
*Coccolithophores*
Cenozoic, worldwide zonation, n. spp.: Bukry, David. 07681
**Puerto Rico**
*Petrology*
South-central, Robles Fm., metamorphism, mineral assemblages: Jolly, Wayne T. 07393
*Stratigraphy*
Cretaceous-Tertiary, upper-lower, northwestern: McIntyre, David H. 00131
**Quaternary**
*Alaska*
White River Valley, glacial chronology: Stuiver, Minze. 07512
*Atlantic Ocean*
Blake Plateau, stratigraphy: Kaneps, Ansis G. 07396
*California*
Irvington, Pleistocene ecosystem: Gordon, Wesley D. 07179
Mammalia, Palm Spring Fm., Pleistocene bat: White, John A. 07235
*Colorado*
Poncha Springs NE quadrangle, Pleistocene outwash and terraces: VanAlstine, R. E. 07719
*Indiana*
Brown County, Pleistocene drift sequence: Schneider, Allan F. 07153
*Kansas*
Dickinson County, Pleistocene, biostratigraphy, paleoecology: Gutentag, Edwin D. 07617
*Kentucky*
Northeastern, pre-Illinoian glaciation: Ray, Louis L. 07623
*Mexico*
Mexico, Tlapacoya area, Mammalia, bone beds: Alvarez, Ticul. 07234
**Quaternary—Continued**
*New York*
Algae, charophytes: Daily, Fay Kenoyer. 07145
*Nova Scotia*
Annapolis-Saint Marys Bay map area, glacial and other deposits: Taylor, F. C. 07241
*Ohio*
Southeastern, pre-Illinoian glaciation: Ray, Louis L. 07623
*Ontario*
Ottawa area, palynology: Mott, R. J. 07601
*Pennsylvania*
Northwestern, Pleistocene stratigraphy: White, George W. 07659
*Rhode Island*
Charlestown-Green Hill barrier bar-lagoon sediments: Dillon, William P. 00096
*Virginia*
James River drainage basin, Nansemond Fm., Pleistocene: Spencer, R. S. 00087
*Yukon*
Saint Elias Mountains, Pleistocene stratigraphy: Denton, George H. 07361
**Quebec**
*Petrology*
Manicouagan cryptoexplosion structure, contact metamorphism: Murtaugh, John G. 07691
Monteregian igneous province, syenitic, gabbroic rocks, immiscibility: Philpotts, A. R. 07636
*Structural geology*
Boundary Mountain anticlinorium, Second Lake anticline: Harwood, David S. 07611
**Radar methods**
*Applications*
Geologic mapping, development: Holmes, Robert F. 07137
**Radar surveys**
*Panama*
Darien Pi[illegible]ce: MacDonald Harold C. 07426
**Radioactivity**
*Clay minerals*
Soils, retention capacities, Panama: Goldsmith, William Alee. 07322
*Granitic rocks*
California, Coast Ranges, Salinian block: Dodge, F. C. W. 07566
**Radioactivity methods**
*Instruments*
Spectrometer, airborne: Darnley, A. G. 07665
Spectrometer, U, Th exploration: Lovborg, L. 07740
X-ray fluorescence analyzer, portable: Duftschmid, K. E. 07741
*Interpretation*
Gamma-ray data, airborne, environmental effects: Foote, R. S. 07666
*Techniques*
Gamma-ray spectrometry, Greenland: Lovborg, L. 07740
**Radioactivity surveys**
*Illinois*
Chicago area: Flint, George M., Jr. 00193
*Indiana*
Chicago (Ill.) area: Flint, George M., Jr. 00193
**Reefs**
*Atlantic Ocean*
Continental margin, south of Cape Hatteras, N. C.: Uchupi, Elazar. 00136
*Barbados*
Pleistocene, diagenesis, porosity changes: Pingitore, Nicholas E., Jr. 07637

**Reefs—Continued**
*Ohio*
Silurian, southwestern, paleocology: Kissling, Don L. 07406
*Virgin Islands*
Anegada Island, emergent: Howard, James F. 07377
**Remote-sensing methods**
*Fluorescence*
Ore deposits exploration: Monroe, John N. 07250
*Instruments*
Airborne pulsed neon laser, nearshore environment: Hickman, G. Daniel. 07139
**Remote-sensing surveys**
*California*
Casa Diablo geothermal area: Steller, David D. 07506
**Reptilia**
*Cretaceous*
Montana, Hell Creek Fm., cf. Lance fauna: Estes, Richard. 07286
**Rhode Island**
*Absolute age*
Charlestown-Green Hill barrier bar-lagoon sediments: Dillon, William P. 00096
*Geomorphology*
Charlestown-Green Hill barrier bar-lagoon, barrier migration: Dillon, William P. 00096
Narrangansett Bay, evolution, structural control: Fisher, John J. 00151
**Rivers**
*Channel geometry*
Bedforms, ground-water microflow systems: Harrison, Samuel S. 07303
Metamorphosis, characteristics, interdependence: Chitale, Shrikrishna V. 00113
Pools, riffles, meanders: Tinkler, Keith J. 00109
Width, effect on bedforms, flume experiment: Crickmore, Maurice J. 00116
*Sediment transport*
Bedforms, effect of channel width: Crickmore, Maurice J. 00116
Bedforms, erodible, dune and antidune genesis: Hayashi, Taizo. 00114
Bedforms, ripple concentration, friction factor: Chang, Fred F. M. 00115
Deposition in gravel bed: Einstein, H. A. 00112
Hydrodynamic lift: Benedict, Barry Arden. 07320
*United States*
Eastern, folded carbonate terranes, flow variability: Parizek, Richard R. 07714
**Salt**
*Geochemistry*
Balance in oceans: Gilluly, James. 00102
**Salt tectonics**
*Mechanism*
Gulf of Mexico, northern, continental slope: Lehner, Peter. 07306
**Sandstone**
*Kentucky*
Flemingsburg quadrangle, occurrence: Peck, John H. 07219
**Saskatchewan**
*Geophysical surveys*
Potash mine, seismic, salt thickness, shaft location: Gendzwill, D. J. 07269
*Hydrogeology*
Good Spirit Lake drainage basin, water balance: Freeze, R. A. 07278
**Saskatchewan—Continued**
*Paleontology*
Palynology, Holocene spectra, vegetation zones: Mott, R. J. 07600
*Sedimentary petrology*
Winnipegosis Fm., anhydrite, calcitization phenomena: Shearman, D. J. 07363
**Sea water**
*Composition*
Analysis, micropore filters, effect of ash content: Spencer, D. W. 07631
Lead concentrations, natural and manmade: Patterson, Clair C. 07248
Mercury, sources, natural and manmade: Klein, David H. 07247
*Geochemistry*
Calcium carbonate solubility: Hawley, J. 07185
Salt, cyclic nature: Gilluly, James. 00102
Textbook: Horne, R. A. 07174
Zinc determination, atomic absorption spectrophotometry, direct: Burrell, David C. 07367
**Sedimentary rocks**
*Alteration*
Nevada, Boyer Ranch Fm., metasomatism: Speed, Robert C. 07500
*Anhydrite*
Fabric, Saskatchewan, Winnipegosis Fm., calcitization: Shearman, D. J. 07363
*Carbonate rocks*
Geochemistry, petrology, Pennsylvania, Middle Ordovician: Rones, Morris. 07754
Mineral composition, Virginia, volcanic zone: Heyman, Louis. 00206
Petrology, Pennsylvania, Lower-Middle Ordovician contact: Chafetz, Henry S. 07739
*Clastic*
Petrology, Wyoming, Hoback Fm.: Spearing, Darwin Robert. 07343
*Composition*
Shale, geochemical standard: Moore, D. M. 07578
*Conglomerate*
General description, provenance, California, Lusardi Fm.: Nordstrom, Charles E. 00204
General description, Virginia, Culpeper basin: Yewisiak, Paul P., Jr. 00190
General description, Wyoming, Heart Lake Conglomerate: Love, J. D. 07613
*Depositional environments*
Marine basins, Cretaceous, cyclic, U.S., Western Interior basin: Kauffman, Erle G. 07237
Pennsylvania, Ordovician carbonates, Lower-Middle contact: Chafetz, Henry S. 07739
Utah, Green River Fm., Eocene indicators: Baer, James L. 07118
*Diagenesis*
Appalachians, Oswego Fm.: Horowitz, Daniel H. 07376
*Distribution*
Volumes, on and adjacent to U. S., Phanerozoic: Gilluly, James. 00102
*Evaporites*
Geochemistry, United States, western, bromine: Holser, William T. 07372
*Limestone*
Petrology, Alaska, Wrangell Mts.: Armstrong, Augustus K. 07722
*Lithofacies*
Appalachians, Ordovician, color origin: Thompson, Allan M. 07522

**Sedimentary rocks – Continued**
*Lithofacies* – Continued
Arkansas, Stanley-Jackforth Fms.: Morris, Robert C. 07729
Desert, cold, indicators: Nichols, Robert L. 07700
Kentucky, Allegheny rocks, deltaic sequence: Whaley, Peter Walter. 07345
Pennsylvania, Allegheny, Conemaugh rocks: Swinehart, James B. 00185
Pennsylvania, Catskill Fm., economic significance: Glaeser, J. Douglas. 00157
United States, Cincinnati arch area, Brassfield Fm.: O'Donnell, Edward. 00171
Utah, Thaynes Fm., Triassic: Smith, Hugh Preston. 07342
Virginia, Harpers Fm., Precambrian-Cambrian: Schwab, Frederic L. 00180
*Methods*
Crossbedding, correcting direction, computer analysis: Parks, James M. 00107
*Shale*
Geochemistry, element associations, metals in black, U.S., midwestern: Vine, James D. 07597
**Sedimentary structures**
*Channels*
Kentucky, western, Pennsylvanian, basal complex: Shawe, Fred R. 07625
*Crossbedding*
Rotation to original position, computer program: Parks, James M. 00107
*Grapestone*
Bahamas, Holocene, genesis: Winland, H. Dale. 07547
*Interpretation*
Alaska, Chitistone, Nizina Limestones, Wrangell Mts.: Armstrong, Augustus K. 07722
Appalachians, Antietam Fm., Cambrian: Schwab, Frederic L. 07484
California, Ventura Basin, Sespe Fm.: McCracken, Willard A. 07434
Paleocurrent basins, delineation, equations: Sturm, Edward. 07513
Virginia, Fossil Point Limestone: Balsam, William L. 00140
Wyoming, Hanna, Carbon Basins, Cretaceous-Eocene: Ryan, J. Donald. 07638
*Ripple marks*
Variability, equations: Tanner, William F. 07516
*Sand waves*
Gulf of California: Marzolf, John E. 07431
**Sedimentation**
*Cyclic*
United States, Western Interior basin, Cretaceous: Kauffman, Erle G. 07237
*Environment*
Anaerobic water, planktonic shells, California: Berger, Wolfgang H. 00085
Beach, barrier bar-lagoon complex, Rhode Island: Dillon, William P. 00096
Delta, Gulf of Mexico, Mississippi cone: Huang, T. C. 07379
Fjord, Greenland, Kangerdlugssuaq area: Berthois, L. 07736
Marine, Oregon, continental shelf: Spigai, J. J. 07501
Ocean, Gulf of Mexico, deep basin: Beall, Arthur O. 07114
Ocean, identification, sediment activation, analysis: Santos, G. G. 07742

**Sedimentation – Continued**
*Experimental studies*
Magnetite deposition over ripples, turbulence variations: McQuivey, Raul S. 07627
*Ocean currents*
Gulf of California, sand waves: Marzolf, John E. 07431
New England, continental rise: Zimmerman, Herman B. 00191
Sediment transport, density interfaces: Bouma, Arnold H. 07562
Transport patterns, Atlantic Ocean, Delaware Bay mouth: Oostdam, B. L. 00173
*Rates*
California, Mono Basin, Pleistocene: Lajoie, Kenneth R. 07634
Kentucky, Ohio River sediments, coal particles: Moore, Bruce R. 00170
*Stream transport*
Gulf of Saint Lawrence, suspended matter: d'Anglejan, B. F. 07362
Hydrodynamic lift: Benedict, Barry Arden. 07320
Suspended sediment, samplers: Knisel, Walter G., Jr. 00117
Suspended silt, deposition in gravel bed, experimental study: Einstein, H. A. 00112
**Sediments**
*Clay*
Geochemistry, metals, P, analyses, Pacific Ocean: Cronan, D. S. 07186
*Ecology*
Caribbean Sea, outer shelf, foraminifer tests, glauconite: Seiglie, George A. 07746
*Environment*
Estuary, Texas, Galveston Bay: Rehkemper, Leonard James. 07338
Lake Erie, settling velocities distributions: Lowright, R. H. 00167
*General*
General description, Gulf of Mexico, Mississippi cone: Huang, T. C. 07379
General description, Pacific Ocean, Bering shelf: Nelson, C. Hans. 07697
General description, Pacific Ocean, Bering shelf, relictglacial: Silberman, M. L. 07491
*Geochemistry*
Greenland, Kangerdlugssuaq fjord: Berthois, L. 07736
Gulf of Mexico, trace elements: Holmes, Charles W. 07136
Louisiana, Mississippi River, South Pass, core: Ho, Clara L. 07143
Marine, interstitial water, heavy metals: Presley, B. J. 07456
Organic components, internal reflection spectroscopy: Mattson, James S. 07246
*Methods*
Electron microscopy, abrasion, turbidity current transport: Margolis, Stanley V. 07576
Electron microscopy, environments, differentiation: Lyall, Anil. 07423
Sampling, suspended sediment, depth-integrating and dip samplers: Knisel, Walter G., Jr. 00117
Suspended detritus, sea water, effect of micropore filters composition: Spencer, D. W. 07631
*Physical properties*
Atlantic Ocean, Wilkinson basin: Richards, Adrian F. 00177

**Sediments – Continued**
*Physical properties* – Continued
Gulf of Mexico, abyssal plain, shear strength: Richards, Adrian F. 07467
New Jersey, Pennsylvania, Delaware River Estuary: Weil, Charles B. 00187
*Provenance*
Greenland, Kangerdlugssuaq fjord: Berthois, L. 07736
Pacific Ocean, Bering shelf, relict: Rathnam, Venkata K. 07462
*Sand*
Textures, differentiation, factor analysis: Beall, Arthur O., Jr. 00197
*Till*
Fabric analysis, interpretation, ice-flow direction: Harris, Stuart A. 07677
General description, Pennsylvania: White, George W. 07659
Physical properties, engineering aspects: White, George W. 07541
**Seismic methods**
*Applications*
Crust and mantle studies: Ritsema, A. R. 07095
Crustal studies, deep sounding: Kosminskaya, I. P. 07102
Oil and gas exploration: Pan, Poh-Hsi. 07350
Potash mines, salt thickness, shaft location, Saskatchewan: Gendzwill, D. J. 07269
*Interpretation*
Leaking modes, layer parameters, influence: Woeber, Arthur Frederick. 07354
Long period leaking modes: Cochran, Michael David. 07348
Seismic modeling, upper mantle structure: Vanek, Jiri. 07074
Surface waves, crustal studies: Brune, James N. 07105
*Reflection*
Continuous profiling, application, sea-floor sediment studies: Ewing, John. 07104
**Seismic surveys**
*Atlantic Ocean*
Continental margin, U.S., interpretation: Uchupi, Elazar. 00136
Crustal studies, model: Ewing, John. 07104
New York shelf, reflection: Garrison, Louis E. 00100
Sohm Abyssal Plain, diapirs, reflection profiles: Watson, Jerry A. 00083
*General*
Crustal studies, surface waves: Brune, James N. 07105
Mantle studies, surface waves: Dorman, James. 07071
*Gulf of Mexico*
Campeche shelf and slope, salt domes: Ballard, J. Alan. 00105
Deep water areas, petroleum exploration: Walker, Jack R. 07273
Northern, continental slope, salt structures, stratigraphy: Lehner, Peter. 07306
*North America*
Crustal studies, review: Healy, John H. 07103
Mantle studies, P-wave velocity, regional variation: Herrin, Eugene. 07106
*Pacific Ocean*
Mantle studies, off California, anisotropy of upper: Raitt, Russell W. 07756
**Seismology**
*Elastic waves*
Attenuation, mantle, dimensionless specific factor: Knopoff, Leon. 07073
**Seismology – Continued**
*Elastic waves* – Continued
Free vibrations, normal modes: Dahlen, Francis Anthony, Jr. 07349
Interpretation, seismic modeling, upper mantle structure: Vanek, Jiri. 07074
P-wave velocity, mantle, variation, North America: Herrin, Eugene. 07106
Surface waves, crustal studies: Brune, James N. 07105
Surface waves, higher modes, Earth structure: Alterman, Z. 07072
Surface waves, phase-velocity dispersion, upper mantle: Dorman, James. 07071
Velocity variations, mantle anisotropy off California: Raitt, Russell W. 07756
**Shorelines**
*Changes*
Realms of influence: Sternberg, Richard W. 07107
Recognition, botanical markers, Florida: Rosenberg, Gary, D. 00212
**Silurian**
*Appalachians*
Northern basin, Salina Group, correlation, Michigan basin: Rickard, Lawrence V. 07108
*Newfoundland*
Magog belt, stratigraphy: Horne, Gregory S. 07375
*Ohio*
Southwestern, reefs, paleoecology: Kissling, Don L. 07406
*Ontario*
Michigan basin, Salina Group, correlation with Appalachian basin: Rickard, Lawrence V. 07108
*United States*
Cincinnati arch area, Brassfield Fm., sedimentation: O'Donnell, Edward. 00171
**Silver**
*Analysis*
X-ray fluorescence, semiconductor detectors: Burkhalter, P. G. 07669
*New England*
New Hampshire-Maine, occurrence: Cox, Dennis P. 00134
**Snow**
*Composition*
Lead concentrations, natural and manmade: Patterson, Clair C. 07248
**Soils**
*Engineering properties*
Clay soils, electrochemical alteration with Al: Gray, D. H. 07265
Fine-grained, consolidation, mathematical model: Hall, Kenneth McCoy. 07317
Land-use planning, mapping: McComas, Murray R. 07277
Moisture transfer on freezing, function of porosity, experiments: Jumikis, Alfreds R. 07747
Seismic responses, sloping base rocks, effects: Dezfulian, Houshang. 07315
*Geochemistry*
Exchange capacity, montmorillonite ions and carbonyls: Doner, H. E. 07264
Exchange capacity, vermiculites, deferration effect: Roth, C. B. 07263
Iron and manganese, X-ray fluorescence determination: Barnhisel, R. I. 07733
Water, salinity determination, in situ: Enfield, C. G. 07732

**Soils – Continued**
*Hawaii*
Volcanic ash source, allophane, chemical properties: Lai, Sung-ho. 07648
*Minnesota*
Goodhue County, biosequence, opal phytoliths: Verma, Shive D. 07647
*North Carolina*
Coastal Plain, fragipan horizons, identification: Steele, Forrest. 07727
*Panama*
Clay minerals, radionuclide retention capacities: Goldsmith, William Alee. 07322
*Trinidad*
Aripo Savannas, genesis, alluvial fan material, weathering: Ahmad, N. 07728
*Wisconsin*
West-central, mineral translocation, albic tongue formation: Ranney, Richard W. 07731
**South Carolina**
*Maps, geologic*
Walhalla area, metamorphic belts, minor structures: Griffin, Villard S., Jr. 07305
*Structural geology*
Walhalla area, folds, migmatitic vs. nonmigmatitic belts: Griffin, Villard S., Jr. 07305
**South Dakota**
*Engineering geology*
Geologic hazards, Rapid City West quadrangle: Cattermole, J. Mark. 07217
*Maps, geologic*
Rapid City West quadrangle: Cattermole, J. Mark. 07217
*Paleontology*
Vertebrata, Oligocene, Chadron, Brule Fms., Big Badlands: Harksen, J. C. 07751
*Stratigraphy*
Oligocene, Chadron, Brule Fms., Big Badlands, type localities: Harksen, J. C. 07751
Rapid City West quadrangle, section: Cattermole, J. Mark. 07217
**Spectroscopy**
*Absorption*
Atomic, spectrophotometry, zinc in sea water: Burrell, David C. 07367
*Activation analysis*
Gold, radiochemical separation, amalgam exchange: Ruch, R. R. 07243
Instruments, equipment for field use: Tolmie, R. W. 07672
Marine sediments, environment identification: Santos, G. G. 07742
Technique, trace-element concentrations: Winchester, J. W. 07671
*Electron probe*
Rock sections, bulk analysis: Stindl, H. 07509
*Flame photometry*
Emission intensity, flame shape and burner configuration: Koirtyohann, S. R. 07257
*Infrared*
Absorption spectrophotometry, integrated with ultraviolet emission spectrography: Liese, Homer C. 07253
Fe, Co, Ni disulfides, bond energies, microhardness: Nickel, Ernest H. 07730
Reflection, internal, organic components, sediments: Mattson, James S. 07246
*Instruments*
Spectrometer, direct-reading, geologic material: Curry, Kenneth J. 07252
**Spectroscopy – Continued**
*Mass*
Coal, laser mass spectrometry, metamorphic chemistry: Given, Peter H. 07212
Instruments, time-programmed spectrometer: Brandt, W. W. 07256
*Ultraviolet*
Emission spectrography, integrated with infrared absorption spectrophotometry: Liese, Homer C. 07253
*X-ray fluorescence*
Alumina and fluorspar: Dryer, H. T. 07254
Emission, counting strategy: Plummer, L. N. 07255
Emission, multiple regression analysis: Strahl, E. O. 07251
Emission, silicates, chemical bonding: Dodd, Charles G. 07188
Instruments, drillhole probe: Rhodes, J. R. 07668
Instruments, portable analyzer: Duftschmid, K. E. 07741
Technique, gold and silver ores: Burkhalter, P. G. 07669
Technique, quantitative analysis, textbook: Birks, L. S. 07129
Technique, soils and concretions, Fe, Mn: Barnhisel, R. I. 07733
**Springs**
*Oklahoma*
Ozark region: Bingham, Roy H. 07275
**Statistical measures**
*Coefficient of variation*
Sampling, ore deposits: Koch, George S., Jr. 07407
**Statistical methods**
*Economic geology*
Regression analysis, hydrocarbon distribution in rocks: Davis, John C. 07593
Response-surface analysis, hydrocarbon distribution in rocks: Davis, John C. 07593
*General*
Cluster analysis, FORTRAN II programs, CLUSTAN I: Wishart, David. 07586
Distribution analysis, count-data fitting, FORTRAN IV program: Ondrick, Charles W. 07584
Probabilistic models, quantification process: Krumbein, W. C. 07409
Trend-surface analysis, mapping technique: Cole, A. J. 07585
Trend-surface analysis, spatial correlation: Watson, G. S. 07536
*Geochemistry*
Variance analysis, element associations in black shales: Vine, James D. 07597
*Hydrogeology*
Trend surface analysis, water-table geometries: Turner, A. Keith. 07526
Trend-surface analysis, Indiana, glacial-outwash aquifer: Davis, L. G. 07274
*Paleontology*
Factor analysis, evolution, entropy: Sadlick, Walter. 07477
Variance analysis, Foraminifera, morphology: Koepnick, Richard B. 07633
*Sedimentary petrology*
Factor analysis, sand, textural data: Beall, Arthur O., Jr. 00197
*Stratigraphy*
Variance analysis, multivariate facies maps, computer processing: Parks, James M. 07590

**Statistical methods – Continued**

*Structural geology*
Trend-surface analysis, spatial filtering: Robinson, J. E. 07591
*X-ray spectrographic analysis*
Multiple regression, matrix corrections: Strahl, E. O. 07251

**Stocks**
*California*
Rocky Hill granodiorite, Visalia area: Putman, George W. 07110
*Colorado*
San Juan Mountains, Ute Creek melasyenite: Barker, Fred. 00133

**Stratigraphy**
*Methods*
Borehole techniques, mountain glacial drift: Rutter, N. W. 07132
Systems analysis, information theoretic approach: McCammon, R. B. 00168
*Principles*
Biostratigraphy, reliability: Stehli, Francis G. 07505

**Strontium**
*Isotopes*
Ratios, Colorado, Ute Creek melasyenite, cf. mantle: Barker, Fred. 00133
Ratios, weathering profile, deep-sea sediments, sedimentary rocks: Dasch, E. Julius. 07183

**Structural geology**
*Methods*
Rock deformation, experimental, apparatus: Donath, Fred A. 00123

**Sulfur**
*Hawaii*
Mauna Loa, Sulphur Cone, sulfur flow: Skinner, Brian J. 00129
*Isotopes*
Ratios, sulfides, related minerals: Thode, H. G. 07520
Sulfide mineral pairs, fractionation: Kajiwara, Yoshimichi. 07395

**Surveys**
*Illinois Geological Survey*
Radiocarbon Dating Laboratory, liquid scintillation counting, progress: Kim, Stephen M. 07244
*Ontario Department of Mines*
Geological Branch, field work summary, 1969: Pye, E. G. 07222
*United States Geological Survey*
Mobile spectrographic laboratory, direct-reading spectrometer: Curry, Kenneth J. 07252
Research, 1969: U.S. Geological Survey. 07602

**Symposia**
*American Association of Petroleum Geologists*
Computer applications to petroleum exploration: Merriam, Daniel F. 07587

**Tectonics**
*Areal studies*
Alaska, south-central: Plafker, George. 07155
Alberta, central, structural trends, spatial filtering analysis: Robinson, J. E. 07591
Bahamas, subsidence, sea-floor spreading: Lynts, George W. 07575
Canada, Rocky Mountains, gravity sliding: Price, Raymond A. 07579
Caribbean region, Lesser Antilles island arc: Fink, Lloyd Kenneth, Jr. 07355
Gulf of Mexico, southern: Weidie, A. E. 07538
Maine, Rangeley area, pre-metamorphic: Moench, Robert H. 07686

**Tectonics – Continued**
*Areal studies* – Continued
Montana, northwestern, disturbed belt, gravity sliding, Tertiary: Mudge, Melville R. 00103
Newfoundland, New World Island area: Horne, Gregory Stuart. 07328
North America, collected papers: King, Philip B. 07130
North America, earthquakes as indicators: Woollard, George P. 07097
Northern Hemisphere, Ordovician continent, faunal correlations: Ross, Reuben James, Jr. 00210
Pacific Ocean, Gorda Escarpment: Silver, Eli A. 07492
Pennsylvania, Triassic basin, evolution: Faill, Rodger T. 07570
South Carolina, Walhalla area, migmatitic vs. nonmigmatitic belts: Griffin, Villard S., Jr. 07305
United States, Appalachian-Ouachita salients, clastic wedges: Thomas, William A. 07521
United States, midcontinent, Keweenawan, magnetic data: King, Elizabeth R. 07405
*Processes*
Continental crust, deformation, movement types: Khain, V. E. 07051
Continental margins: Drake, Charles L. 07054
Continental margins, rifted and compressional, models: Schneider, Eric D. 07581
Convection in mantle: Runcorn, S. K. 07162
Displacements, strain, tilt fields, evaluation: Press, Frank. 07100
Earthquakes, relations: Petrushevsky, B. A. 07075
"Hovercraft tectonics," Wyoming, Heart Mtn. fault: Hughes, Charles J. 00198
"Hovercraft tectonics," Wyoming, Heart Mtn. fault: Pierce, William G. 00097
Midoceanic ridge system, earthquake evidence: Sykes, Lynn R. 07098
Orogenic belts, batholith emplacement: Simonen, Ahti. 07069
Pacific Ocean, magnetic anomalies: Vacquier, Victor. 07084
Sea-floor spreading, continental drift, magnetic reversal stratigraphy: Vine, F. J. 07534
Sea-floor spreading, deformation diagram: Kupfer, Donald H. 07411
Sea-floor spreading, mantle, fractional melting and lateral differentiation: Ringwood, A. E. 07087
Sea-floor spreading, suboceanic lithosphere, evolution: Press, Frank. 07457
Sea-floor spreading, thermal character of stresses: Knopoff, Leon. 07160

**Tennessee**
*Geochemistry*
Copper Ridge, geochemical prospecting: Perhac, Ralph M. 07441

**Tertiary**
*Alaska*
Wrangell Mountains, glaciation: Denton, George H. 07238
*Angiosperms*
Araliaceae, Eocene, taxonomy: Dolph, G. E. 07150
*Arizona*
Tonalea area, tuff, correlation, Bidahochi Fm.: Wright, James C. 07616
*Atlantic Ocean*
Blake Plateau, stratigraphy: Kaneps, Ansis G. 07396

**Tertiary—Continued**
*Atlantic Ocean*—Continued
Continental margin off Florida, JOIDES cores, stratigraphy: Charm, W. B. 07157
*California*
Coalinga area, Miocene-Pliocene, stratigraphy, paleontology: Adegoke, Oluwafayisola S. 07284
Coast Ranges, stratigraphy: Oakeshott, Gordon B. 00216
Kettleman Hills, sedimentation, Pliocene: Stanton, Robert J., Jr. 07504
Ventura Basin, Sespe Fm., sedimentation: McCracken, Willard A. 07434
*Colorado*
Poncha Springs NE quadrangle, stratigraphy: VanAlstine, R. E. 07719
*Correlation*
Protista, calcareous nannofossils, worldwide zonation, n. spp.: Bukry, David. 07681
*Florida*
Gastropoda, lucinid taxonomy, *Miltha*: Vokes, Harold E. 07679
Pelecypoda, Chipola Fm., Miocene, lucinid, n. sp.: Vokes, Harold E. 07680
*Mammalia*
Mesonychid condylarths, feeding mechanism, evolution: Szalay, Frederick S. 07368
*Maryland*
Potomac River valley, Brightseat, Aquia Fms.: Kauffman, Erle G. 07398
*Montana*
Northwestern, tectonics: Mudge, Melville R. 00103
*New Jersey*
Cretaceous-Tertiary datum, biostratigraphy: Olsson, Richard K. 00172
*North Dakota*
Western, Golden Valley Fm., Paleocene-Eocene: Hickey, Leo J. 07138
*Nova Scotia*
Sable Island test well, stratigraphy: Pamenter, Bev. 00092
*Oregon*
Wheeler County, Pisces, John Day Fm.: Cavender, Ted. 07276
*Puerto Rico*
Northwestern, stratigraphy: McIntyre, David H. 00131
*South Dakota*
Big Badlands, Chadron, Brule Fms., Vertebrata: Harksen, J. C. 07751
*Utah*
Central, Green River Fm., lower, cycles: Baer, James L. 07118
*Virginia*
Potomac River valley, Brightseat, Aquia Fms.: Kauffman, Erle G. 07398
*Wyoming*
Hanna, Carbon Basins, sedimentation: Ryan, J. Donald. 07638
Western, Hoback Fm., sedimentation: Spearing, Darwin Robert. 07343

**Texas**
*Absolute age*
Galveston Bay, Holocene deposits, C-14: Rehkemper, Leonard James. 07338
*Economic geology*
Petroleum, Anadarko basin, western, Marmaton Group: Cambridge, Thomas R. 07213
*Hydrogeology*
Capitan Limestone, aquifer, computer simulation: Peterson, J. B. 07635

**Texas—Continued**
*Hydrogeology*—Continued
Llano Estacado, Ogallala Fm., ground-water conditions duringaccumulation: Theis, C. V. 07519
Western, Capitan Limestone, study methods: Hiss, W. L. 07141
*Paleontology*
Palynomorphs, Pennsylvanian, Eddleman Coal, Young County: Stone, J. Fred. 07661
*Sedimentary petrology*
Anadarko basin, western, Marmaton Group, oil reservoirs: Cambridge, Thomas R. 07213
Galveston Bay, Holocene deposits, sedimentation: Rehkemper, Leonard James. 07338
Western, carbonate spit-channel couplet: Moore, Clyde H., Jr. 07688

**Thermodynamic properties**
*Bentonite*
Heats, entropies of exchange, metal cations: Gast, R. G. 07645
*Fugacity*
Olivine-pyroxene reactions, oxygen: Williams, Richard J. 07544
Talc, effect on cell dimensions: Forbes, Warren C. 07198
*Hydrothermal systems*
Sulfide deposition, model: Helgeson, Harold C. 07360
*Ionic crystals*
Equations of state: Zharkov, V. N. 07059
*Magnesium silicates*
Dissolution: Luce, Robert W. 07422
*Metals*
Equations of state: Zharkov, V. N. 07059
Melting temperature pressure curve: McLachlan, Dan, Jr. 07436
*Sphalerite*
Geobarometry: Scott, S. D. 07485

**Thermoluminescence**
*Carbonates*
$Mn^{+2}$-activated: Sommer, Sheldon E. 07497
*Fluorite*
Thermal modification: Semec, Branko. 07488
*Zircon*
Metamictization relations: Vaz, J. Eduardo. 07531

**Thorium**
*Greenland*
Ilimaussaq intrusion, exploration, gamma-ray spectrometry: Lovborg, L. 07740

**Titanium**
*Virginia*
Roseland district, rutile-ilmenite placers: Herz, Norman. 00215

**Trace elements**
*Analysis*
Neutron activation techniques: Winchester, J. W. 07671

**Trace-element analyses**
*Clay*
Pelagic, Pacific Ocean, metals, P: Cronan, D. S. 07186
*Fluorapatite*
Mexico, Cerro de Mercado: Young, E. J. 07724
*Natural gas*
United States, helium and other elements: Cardwell, L. E. 00078
*Prehnite*
Lake Superior region, Isle Royale: Huber, N. King. 07723

**Tracks and trails**
*Borings*
North Carolina, continental shelf, diagnostic patterns: Perkins, R. D. 07442
*Burrows*
Modern bivalves, experimental study: Flessa, Karl W. 00152
**Triassic**
*Alaska*
Wrangell Mountains, Chitistone, Nizina Limestones, sedimentation: Armstrong, Augustus K. 07722
*Utah*
North-central, Thaynes Fm., sedimentation: Smith, Hugh Preston. 07342
**Trilobita**
*Ordovician*
Northern Hemisphere, Middle, Whiterock stage, faunal correlation: Ross, Reuben James, Jr. 00210
**Trinidad**
*Sedimentary petrology*
Aripo Savannas, alluvial fan material, soil genesis: Ahmad, N. 07728
**Unconformities**
*Pennsylvania*
Mississippian, northeastern: Sevon, William D. 00181
**United States**
*Areal geology*
Northeastern, continental shelf, history: Oldale, R. N. 07706
Western, popular account: Sutton, Ann. 07169
*Economic geology*
Gypsum, midwestern, resources: Cleveland, John H. 07152
Natural gas, composition, analyses: Cardwell, L. E. 00078
*Geochemistry*
Midwestern, black shales, element associations, analysis: Vine, James D. 07597
Western interior, evaporites, bromine chemistry: Holser, William T. 07372
*Geomorphology*
Southeastern, capes, shoals, evolution: Hoyt, John H. 07378
*Geophysical observations*
Gravity, regional variations, evaluation: Woollard, George P. 07078
*Geophysical surveys*
Continental, regional, magnetic,interpretation: Ostenso, Ned A. 07065
Magnetotelluric, selected areas: Renick, Howard, Jr. 07351
Midcontinent, magnetic, possible rift system: King, Elizabeth R. 07405
Western, satellite magnetometer observations, anomalies: Zietz, Isidore. 07558
*Paleoclimatology*
Cambrian, north-central, northeastern, wind directions: Seeland, David A. 07487
*Paleontology*
Algae, Pennsylvanian, Leavenworth Ls., midcontinent: Toomey, Donald Francis. 07239
Crinoidea, Carboniferous, central, acrocrinids, taxonomy: Moore, Raymond C. 07738
Ostracoda, Cretaceous, Cenomanian deposits, index fossil: Hazel, Joseph E. 07618
*Sedimentary petrology*
Cincinnati arch area, Brassfield Fm., lithofacies: O'Donnell, Edward. 00171
**United States—Continued**
*Sedimentary petrology*—Continued
Phanerozoic sediment volumes, significance: Gilluly, James. 00102
Southeastern, continental shelf, clays, sedimentation: Pevear, D. R. 07446
Southeastern, continental shelf, sediment dispersal: Stevenson, Robert E. 07508
Western Interior basin, Cretaceous marine cycles: Kauffman, Erle G. 07237
*Stratigraphy*
Cretaceous, Western Interior basin, cycles: Kauffman, Erle G. 07237
Ordovician, Middle, eastern, correlation: Raring, A. W. 07461
*Structural geology*
Appalachian-Ouachita salients, clastic wedges, tectonics: Thomas, William A. 07521
Crust and mantle, magnetic survey data: Ostenso, Ned A. 07065
**Uplifts**
*Idaho*
Snake River Plain, Quaternary lava domes, distribution: Stone, George Thomas. 07511
*Wyoming*
Yellowstone Park, Basin Creek uplift, evolution: Love, J. D. 07613
**Uranium**
*Arizona*
Garnet Ridge, genesis: Gavasci, Anna Teresa. 07326
*Canada*
Exploration, techniques, sequence: Little, H. W. 07664
*Exploration*
Well logging, gamma-ray: Hawkins, W. K. 07667
*Greenland*
Ilimaussaq intrusion, exploration, gamma-ray spectrometry: Lovborg, L. 07740
*Isotopes*
Ratios, ground water, Florida: Rydell, Harold Stanford. 07340
U-234/U-238, disequilibrium, use in hydrologic studies: Kaufman, M. I. 07126
**Utah**
*Absolute age*
Southeastern, Mule Ear diatreme: Naeser, C. W. 07692
*Economic geology*
Oil sands, occurrence, potential: Ritzma, Howard R. 07124
Polymetallic ores, Star Range, occurrence: Baetcke, Gustav Berndt. 07325
*General*
Catalog, samples, cores, logs, index: Fox, R. Chris. 07221
*Hydrogeology*
Great Basin, ground water, quality: Handy, A. H. 07626
*Sedimentary petrology*
Central, Green River Fm., lower, cyclic sedimentation: Baer, James L. 07118
North-central, Thaynes Fm., lithofacies: Smith, Hugh Preston. 07342
*Stratigraphy*
Eocene, Green River Fm., lower, cycles, paleoecology: Baer, James L. 07118
Paleozoic-Mesozoic, Star Range: Baetcke, Gustav Berndt. 07325
*Structural geology*
Henry Mountains, concordant intrusions, evolution: Pollard, David D. 07453

**Vertebrata**
*Cretaceous*
Montana, Hell Creek Fm., lower classes, cf. Lance fauna: Estes, Richard. 07286
*General*
Fossil collections, interpretation, Cenozoic vs. pre-Cenozoic: Hotton, Nicholas, 3d. 07676
*Oligocene*
South Dakota, Chadron, Brule Formations, Big Badlands, lists: Harksen, J. C. 07751
*Textbooks*
Evolution: Colbert, Edwin H. 07366
**Virgin Islands**
*Geomorphology*
Anegada Island, emergent reef: Howard, James F. 07377
**Virginia**
*Economic geology*
Heavy minerals, rutile-ilmenite placers, Roseland district: Herz, Norman. 00215
*Geochemistry*
Arvonia Fm., metamorphic Fe-rich, chemical equilibrium: Smith, Kenneth G. 07496
*Geomorphology*
James River basin, Pleistocene history: Spencer, R. S. 00087
*Maps, mineral resources*
Roseland district, heavy minerals: Herz, Norman. 00215
*Paleontology*
Paleocene, Brightseat, Aquia Fms., Potomac River valley, paleoecology: Kauffman, Erle G. 07398
*Petrology*
Goode quadrangle, metamorphic rocks, textures: Khoury, S. G. 00164
*Sedimentary petrology*
Austinville, Fossil Point Limestone, structures: Balsam, William L. 00140
Culpeper basin, conglomerates: Yewisiak, Paul P., Jr. 00190
Harpers Fm., paleocurrents, environments: Schwab, Frederic L. 00180
James River basin, Nansemond Fm., gravel zones, basin history: Spencer, R. S. 00087
Russell County, Blackford Fm., mineral compositons, volcanic zone: Heyman, Louis. 00206
*Stratigraphy*
Pennsylvanian, southwestern: Miller, Ralph L. 07684
*Structural geology*
Culpeper basin: Yewisiak, Paul P., Jr. 00190
**Volcanism**
*Causes*
Plateau basalt extrusion, regionally protracted heat energy: Kuno, Hisashi. 07060
*Effects*
Major disasters, casualties, potential dangers: Latter, J. H. 07116
**Volcanoes**
*General*
Magnetic anomalies, characteristics: Malahoff, Alexander. 07086
*Hawaii*
Mauna Loa, Sulphur Cone, sulfur flow: Skinner, Brian J. 00129
**Washington**
*Absolute age*
Okanogan Range, Cretaceous orogenic phase: Menzer, Fred J., Jr. 00200
**Washington—Continued**
*Areal geology*
Chelan quadrangle, southern half: Waters, Aaron C. 07344
Cumberland, Hobart, Maple Valley quadrangles: Vine, James D. 07720
Mount Rainier National Park, surficial: Crandell, Dwight R. 07181
*Economic geology*
Coal, Cumberland, Hobart, Maple Valley quadrangles: Vine, James D. 07720
*General*
University, Department of Oceanography, coastal environment courses: Sternberg, Richard W. 07107
*Geochemistry*
Okanogan Range, igneous rocks, analyses: Menzer, Fred J., Jr. 07439
*Maps, geologic*
Cumberland, Hobart, Maple Valley quadrangles: Vine, James D. 07720
Mount Rainier National Park, surficial: Crandell, Dwight R. 07181
**Weathering**
*Arid climate*
Biotite, iron oxidation, compared with humid, experimental study: Ismail, F. T. 07202
*Experimental studies*
Silicates, organo-chemical processes: Huang, W. H. 07380
*Mica*
Fungi role, experimental study: Weed, S. B. 07646
*Minnesota*
Goodhue County, soil biosequence, opal phytoliths: Verma, Shive D. 07647
*Temperate climate*
Silicate rocks, chemical, erosive significance: Janda, Richard J. 07389
*Urban atmosphere*
Architectural stone, salt burst, hydration pressure: Winkler, E. M. 00111
**Well logging**
*Electrical*
Application, mountain glacial drift stratigraphy: Rutter, N. W. 07132
*General*
Catalog, logs, Utah: Fox, R. Chris. 07221
Logs, cores, subsurface, catalog 1963-67, Ohio: Safford, Frederick B. 07120
Methods, summary: Kelley, Dana R. 07654
*Radioactivity*
Instruments, X-ray fluoresence probe: Rhodes, J. R. 07668
Interpretation, Pennsylvania, Mercer County, Temple well: Wagner, Walter R. 07649
Interpretation, Salina Group, Appalachian-Michigan basins, correlation: Rickard, Lawrence V. 07108
Interpretation, zinc contents, gamma-ray back scattering: Donhoffer, D. K. 07663
Methods, gamma-ray, uranium prospecting: Hawkins, W. K. 07667
*Temperature*
Data, Northwest Territories, Reindeer well: Jessop, A. M. 00093
**Wells and drill holes**
*Atlantic Ocean*
Continental margin off Florida, JOIDES cores: Charm, W. B. 07157
*Florida*
Well and water-level data, 1965-66: Healy, Henry G. 00081

**Wells and drill holes—Continued**
*Gulf of Mexico*
Sediment data, deep-sea cores: Beall, Arthur O. 07114
*Ontario*
Michigan basin, well logs, Salina Group: Rickard, Lawrence V. 07108
*United States*
Appalachian basin, well logs, Salina Group: Rickard, Lawrence V. 07108
**West Virginia**
*Engineering geology*
Environment-urban planning program: Wilson, Peter G. 00189
*Geomorphology*
Burning Springs area, lineament analysis, radar: Wing, Richard S. 07546
**Wisconsin**
*Mineralogy*
Clay minerals, west-central, translocation, albic tongue formation: Ranney, Richard W. 07731
*Sedimentary petrology*
West-central, soils, albic tongue formation: Ranney, Richard W. 07731
**Wyoming**
*Geochemistry*
Bighorn Mountains, amphibolite: Uthe, R. E. 07527
Mowry Shale, hydrocarbon distribution, regression analysis: Davis, John C. 07593
*Paleontology*
Pisces, Cretaceous, Lance Fm., new albulid: Estes, Richard. 07285
*Sedimentary petrology*
Hanna, Carbon Basins, Cretaceous-Eocene paleocurrents: Ryan, J. Donald. 07638
Western, Hoback Fm., sedimentation: Spearing, Darwin Robert. 07343
*Stratigraphy*
Cenozoic, Heart Lake Conglomerate, Yellowstone Park: Love, J. D. 07613
*Structural geology*
Bighorn Mountains, Laramide trends: Hoppin, Richard A. 07374
Heart Mountain detachment fault, mechanism: Hughes, Charles J. 00198
Heart Mountain detachment fault, mechanism: Hughes, Charles J. 00205
Heart Mountain detachment fault, mechanism: Pierce, William G. 00097
Yellowstone Park, Basin Creek uplift, evolution: Love, J. D. 07613
**X-ray diffraction analyses**
*Data*
Clays, Pennsylvania, Monroe County: Epstein, Jack B. 07610
**X-ray diffraction analysis**
*Data*
ASTM Powder data file, manual and computer aids for use: Hanawalt, J. H. 07249
Cordierite, polymorphism: Langer, K. 07201
Hydrobasaluminite, Indiana: Sunderman, Jack A. 07195
Kaolinite, transformation to metakaolin: Mitra, G. B. 07199
Sonolite, alleghanyite, leucophoenicite, New Jersey: Cook, David. 07197
Staurolite, ordering differences: Dollase, W. A. 07567
Vivianite, earthy, thermal studies: Tien, Pei-lin. 07194
*Methods*
Clay minerals, mounting on ceramic tile: Rich, C. I. 07734
**Yukon**
*Absolute age*
Saint Elias Mountains, C-14, glacial chronology: Denton, George H. 07361
*Economic geology*
Mineral resources, summary 1968: Findlay, D. C. 07128
*Glacial geology*
Saint Elias Mountains, northwestern, drift sheets, glaciation periods: Denton, George H. 07361
*Stratigraphy*
Pleistocene, Saint Elias Mts., northeastern: Denton, George H. 07361
**Zinc**
*Analysis*
Atomic absorption spectrophotometry, direct, sea water: Burrell, David C. 07367
*Exploration*
Well logging, gamma-ray back scattering technique: Donnoffer, D. K. 07663
*Kansas*
Picher field, occurrence, genesis: McKnight, Edwin T. 00207
*New England*
New Hampshire-Maine, occurrence: Cox, Dennis P. 00134
*New Jersey*
Sterling Hill, structure: Metsger, Robert W. 07682
*Oklahoma*
Picher field, occurrence, genesis: McKnight, Edwin T. 00207

☆ U.S. GOVERNMENT PRINTING OFFICE : 1970—302-618/12